THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVI. No. 1697.] LONDON, NOVEMBER 19, 1895. [47TH YEAR. PRICE 6d.

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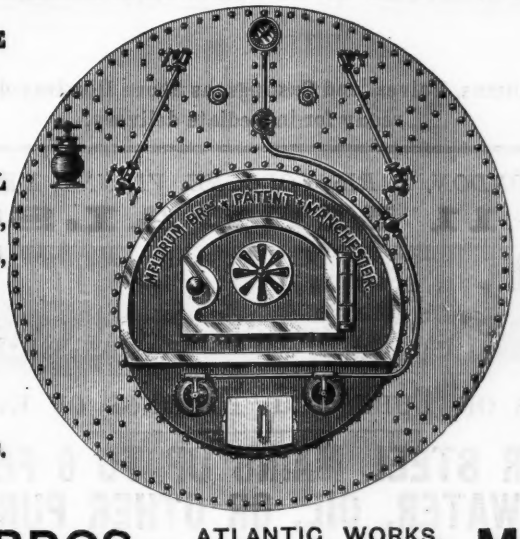

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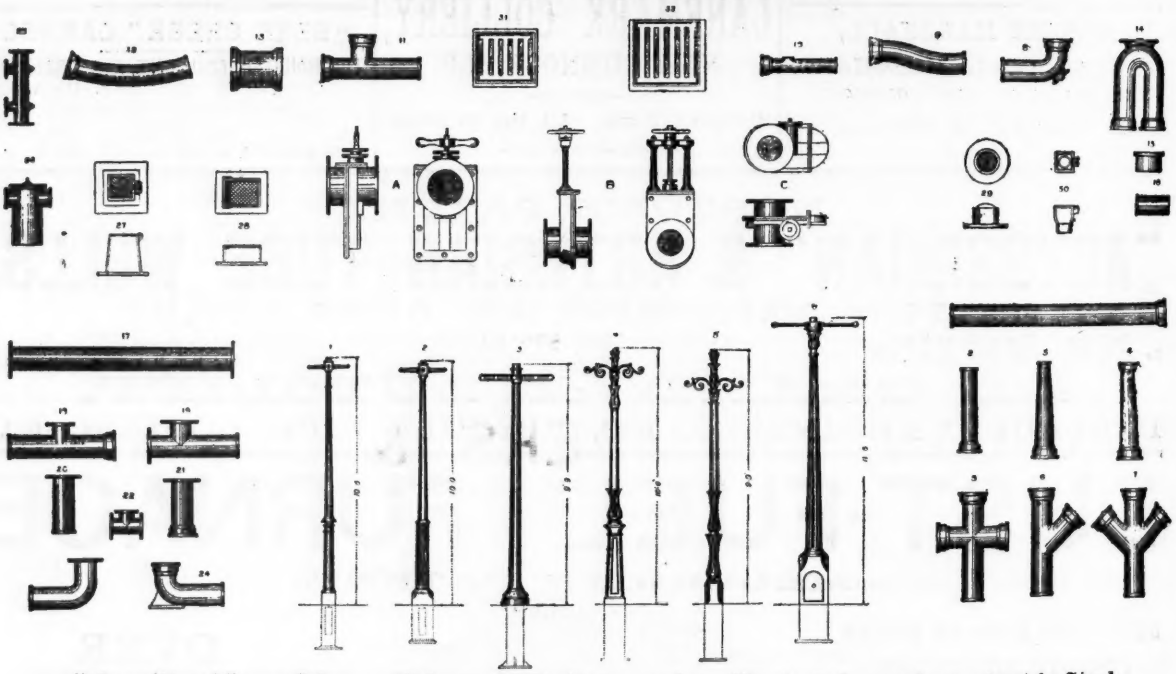

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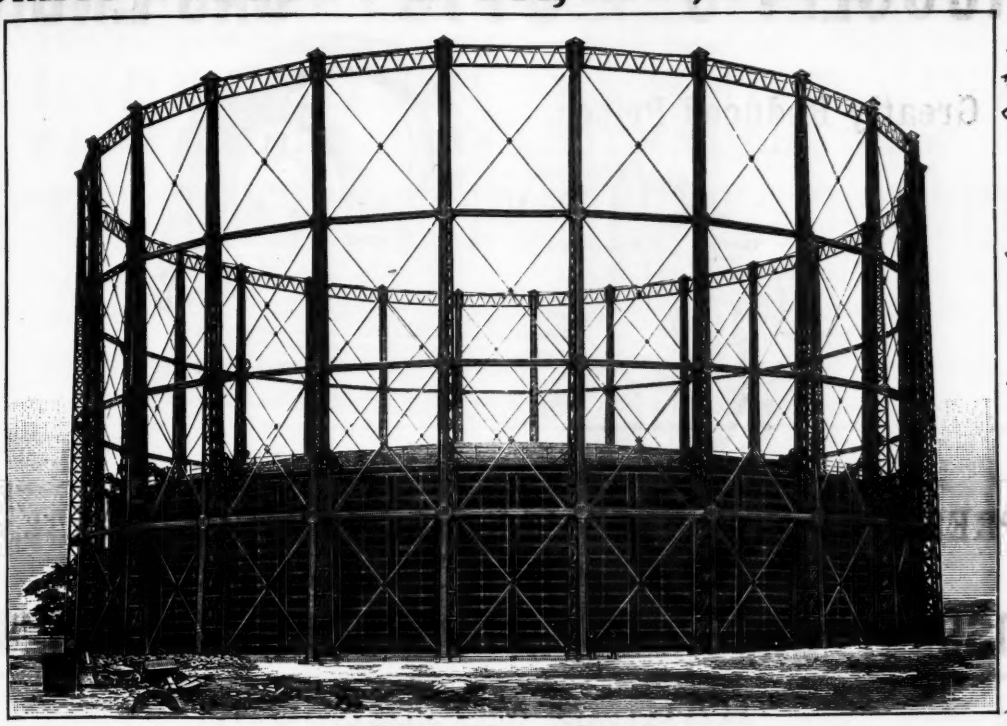

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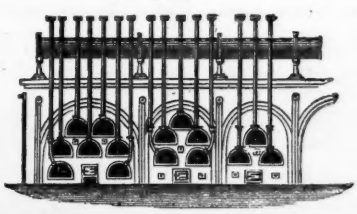

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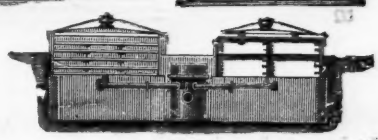

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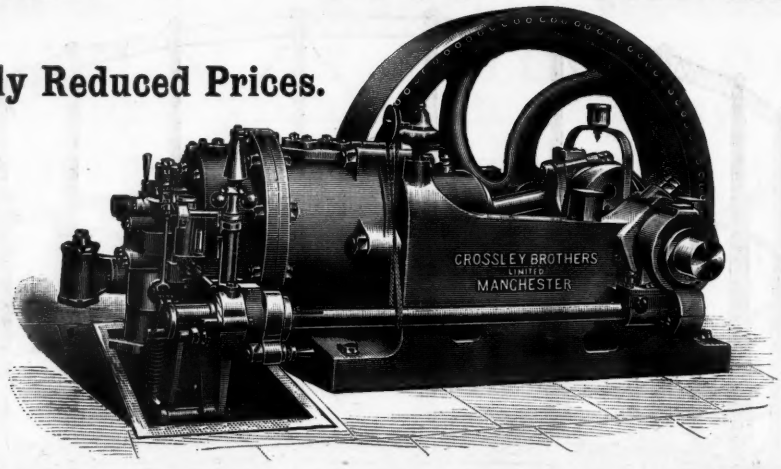

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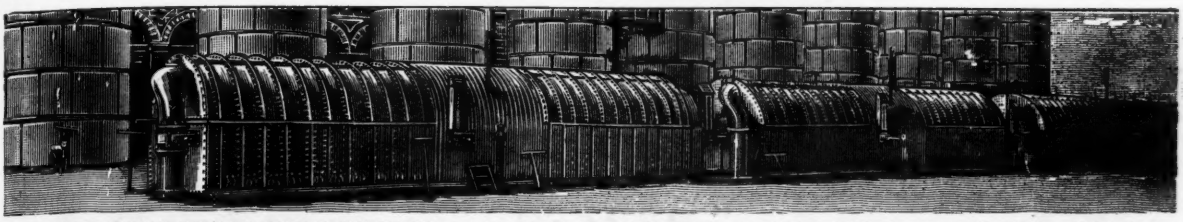

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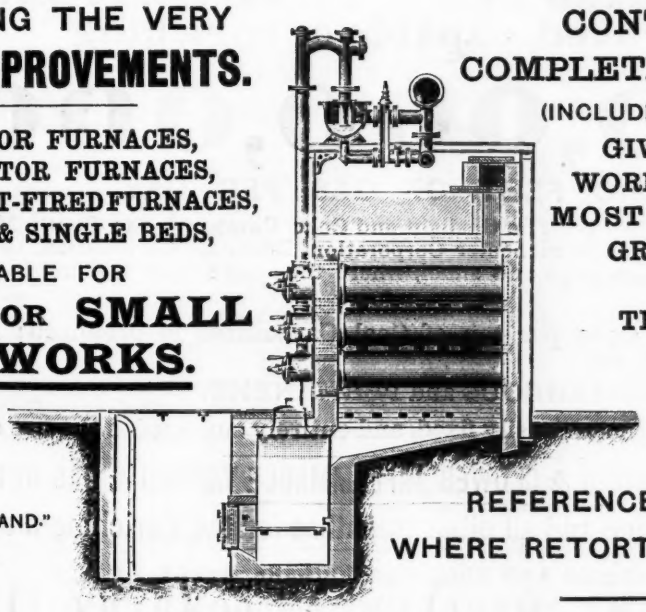

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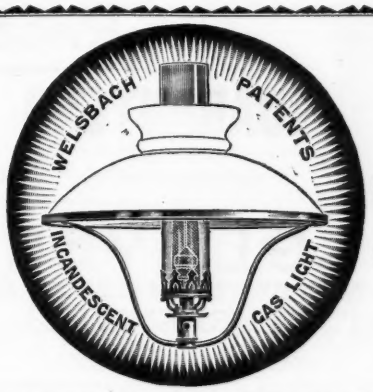

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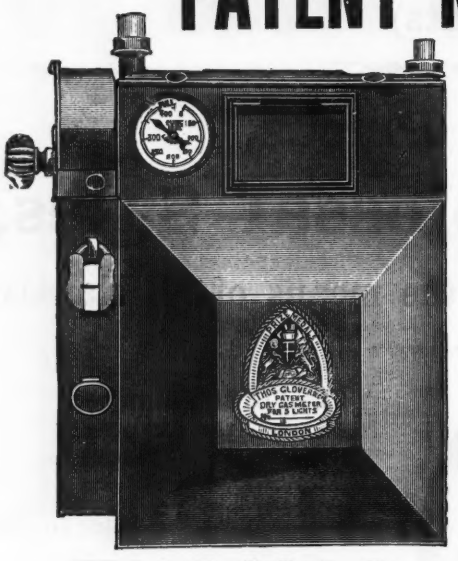

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[See also Advt. p. 1064.

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EDITORIAL NOTES.

The Southern District Meeting—The Amalgamation Proposal.

THE members of the Southern District Association of Gas Managers held their autumn meeting last Thursday, at the Holborn Restaurant, under the presidency of Mr. S. W. Durkin, of Southampton, who is to be succeeded in the chair by Mr. A. F. Browne, of the South Metropolitan Gas Company. Two papers were read on this occasion, by Mr. C. C. Carpenter and Mr. A. E. Broadberry respectively; and both were discussed. Besides this formal and technical business, Mr. F. G. Dexter, of Winchester, gave the members a brief but interesting account of his triumphant progress in the substitution of incandescent gas-burners for the oil street-lamps which have characterized, without adorning, the streets of that city for many years past; and the proceedings wound up with a short but pregnant discussion of the proposal emanating from the South-Western Association for amalgamating this body with the Southern organization. It will be gathered from this summary of the transactions of the meeting, that there was plenty to occupy and interest the members for the couple of hours of their assembly; and this was so conspicuously the truth, that anyone who might have happened to be present just as a visitor, would have formed the opinion that the Southern is a particularly lively and successful example of the order of Associations to which it belongs. We shall not now discuss the papers read, which were both good in their degree, and raised interesting questions; but take the opportunity for offering a few observations on the topic of the amalgamation proposal.

The meeting presented a good opportunity for bringing a project of the kind "within the range of practical "politics;" being well attended, and favoured, as usual, with the presence of several of those who founded the Southern Association, and have never ceased to interest themselves in its organization and transactions. Immediately the subject of the proposed amalgamation was broached, it became apparent to the whole company that if the more active spirits hitherto identified with the South-Western experienced a desire to join their forces to those of the Southern Association, there existed, among the members of the latter body, no very great feeling of reciprocity in this regard. It was rather understood than expressed that the advantages of the proposed formal union were sought by the South-Western representatives for their own benefit, while there was not so much as a pretence that the Southern Association could gain anything by the fusion. Still, the Southern men took the overtures of their neighbours and would-be allies in good part, and paid them the compliment of remitting the question of union to a Special Committee, with instructions to consider and report upon it to the next meeting of the Association.

Without pretending to forecast the result of the deliberations of this Committee, it is easy to perceive why the South-Western men, or some of them, would like to come into the scope of the Southern organization, and also why such an extension of the range of the Association as would be involved in the appropriation of the whole South-Western district would not be favoured by the members of the Southern society. These reasons are identical with those to which the success and vitality of the one technical society, and the failure and moribund condition of the other, are to be attributed. It is not merely because one of these Associations happens to include London in its district that it is living and doing well; although, of course, this consideration has something to do with it. As a matter of fact, with a few brilliant exceptions, the London gas engineers and managers, strictly so called, are not a "clubbable" set, and are rarely to be seen, and more rarely heard from, at technical society meetings. Even of greater importance to the Gas Managers' Association which includes it in its sphere of influence is the fact that London is a centre, in the same sense as Birmingham and Manchester are centres, of the industry of gas lighting—only more so. The prosperity of the Southern Association is largely due to the circumstance, upon which Mr. J. L. Chapman laid due stress in his weighty speech on Thursday, that all its business meetings have been held in London, the natural centre of the district, to which all roads lead. One great weakness of the South-Western Association has been the absence of any such headquarters. Bristol might have been made to serve the

purpose of such a centre for the West of England and South Wales. But the necessity for such a central rallying point was not recognized by the South-Western Association, which has suffered from the character of the region of country from which its title was drawn. In following up the geographical idea, the Association got into the way of losing itself in inaccessible spots all over the sparsely-peopled kingdom of Wessex, with the natural result that its hold upon the allegiance of its widely-scattered members has now waned to the vanishing-point. And there has been nobody in the part of England supposed to be served by the Association to take much interest in its maintenance.

It stands confessed, by the acceptance by its members of the suggestion for amalgamation with the Southern Society, that the South-Western Association cannot carry on its independent existence. On the other hand, there is no hard-and-fast line of delimitation of the sphere of influence of the very active Southern Association; and it is not to be supposed that any otherwise duly qualified candidate for membership of the latter body will be held disqualified merely through there being a high degree of "westering" in his "southing." But—and this is the *sine quâ non*, as Mr. Chapman well put it—those who contemplate coming to the Southern, for their own reasons, must not expect the Southern to go to them, even for a holiday outing. The prospects of District Gas Managers' Associations are not so bright everywhere that the prosperity of one of the most fruitful and well-supported of them all can be jeopardized by laying it under geographical disabilities that have already proved disastrous to their natural victims.

The Truth about the Clyde Lock-Out.

MATTERS remain pretty much as they were in connection with the Belfast and Clyde engineers' strike; but since we wrote on the subject last week, information has come to hand that fully justifies the reserve we then showed in respect to the apportionment of blame for bringing about a condition of affairs in these shipbuilding centres which almost amounts to a national peril. According to a communication from the special correspondent of *The Times*, published last Wednesday, there is no foundation for the allegation, so freely made by Mr. Frederic Harrison and others who have hastened to take the "popular" view of the matter, that the action of the Clyde employers was a "sympathetic" lock-out, in the same sense as the qualification bears when applied to a strike. In this sense, as *The Times* correspondent observes, the word "sympathy" is a synonym for "criminal folly." It is a great relief to those who could not bring themselves to believe the Clyde shipbuilders capable of following the example of the discredited leaders of the New Unionism, to receive the assurance, supported by incontrovertible evidence, that the allegation in question is baseless. The facts as stated, and nowhere contradicted, are briefly that the engineers employed at Clydebank began the whole business so long ago as March 29, by preferring a demand for an increase of wages by ¾d. per hour, coupled with the proviso—here the "cloven hoof" of militant Trade Unionism showed itself—that the advanced rate of pay should be regarded as the "irreducible minimum." The employers were given four days to make up their minds whether to submit to these terms or be subjected to a strike. The firm replied by declaring that the matter must be referred to their Association. But this did not at all satisfy the men, who, for all their habitual clamouring for "recognition of the Union," replied to the effect that they did not wish to have anything to do with the Association, but preferred to settle the question with their employers individually. The Association did, however, look into the matter, and found that full wages were being paid at this particular works, and that, although there was a press of work in this yard, there were plenty of engineers idle along the Clyde. With regard to the question of the minimum wage, moreover, the Association ascertained that the principle did not work satisfactorily anywhere; and they declined to recognize it. The men put up with their defeat on this occasion, and the threatened strike did not come off. The questions of a minimum wage and an increase were raised again in August; but no settlement was arrived at—the only positive result of all this agitation being to show the employers what was in preparation for them if they allowed themselves to be cornered piecemeal. Consequently, the Association was cemented; and the shipbuilding interests of Belfast and the Clyde were federated. The next move on the part of the Union was made at Belfast; but the demand was substantially identical for both centres of employment, and was treated as such, with results that need not be further described. It is thus an absurdity to accuse the Clyde employers of having been inspired by any other motive than that of self-defence when they showed, to the amazement of the Trade Unionists, that they were able to see through the "change of venue" of their agitation from the Clyde to Belfast.

For the present, no settlement of the difficulty is in sight. It is not to be regretted that, so far, neither party has welcomed the intervention of would-be conciliators from without; and it is greatly to the men's credit that they would not allow a notorious agitator, whose object can hardly be imagined to be pacification, to address them. We cannot help thinking that, if the employers will only remain true to themselves and their cause, the Trade Union will eventually give way. Some readjustment of wages may be arranged for, if and when an improved state of trade shall permit. But there will be no victory of Trade Union principles in this eventuality. On the other hand, the Amalgamated Society of Engineers are not in a position, financial or otherwise, to stand out long for any such proviso as that of the "minimum" wage, which is only another name for the socialistic "fad" of the "living" wage. Perhaps when this demand is finally abandoned, the rank and file of the Society men, in whose supposed interest it is preferred, will begin to ask themselves whether this and other asserted Trade Union "principles" that might be named are not figments belonging rather to the stock-in-trade of the professional agitator than elements at all necessary to the prosperity of national industry and of those who live by it.

Deputations to Ministers.

THE coming parliamentary session is now being preluded in the usual way by public meetings at which party leaders enjoy opportunities for expounding their policy that are not always so fruitful of information in this regard as the conveners would like; and the season of daily deputations to Ministers popularly supposed to be incubating next year's legislative programme has also set in with particular severity. The latter kind of overture to a session of Parliament appears, indeed, to be growing in popularity among the large and increasing classes of people who either charge themselves, or are charged by others, with attempts at directing the course of legislation. In order to discern the reason for this growth of the deputation system, which is quite a modern feature of political and administrative life, it is necessary to inquire into the nature of the motive power of Parliaments and Governments. This is no other than that public opinion, which is as great a mystery as electricity, energy, matter, or any other of the cosmic forces by the rightful direction and employment of which men and nations live, and in consequence of the misuse or ignorance of which they perish. The poet who asked in melodious numbers to be told where Fancy is bred, raised an easy question in comparison with that which would ascertain the sources of public opinion. Statesmen and legislators can do nothing unless they are in accord with, and supported by, this living force. Wherefore it is their first duty to make sure of establishing their connection with it. Happily, or the reverse, there is never a lack of voices claiming to express public opinion respecting everything under the sun, for the guidance of those who are expected to employ this force to the general advantage. Newspapers and printed publications of every description and character ask for public patronage simply on account of the fidelity and skill with which they represent current opinions regarding the subjects of which they treat. But nobody accepts the words of a writer as conveying the truth, the whole truth, and nothing but the truth of the matter he takes in hand. There is a strong, and, on the whole, a laudable desire on the part of whoever desires, in these days of much speaking and writing, to arrive at the truth of a social, political, or industrial problem, to get behind and beneath all the verbiage which inevitably gathers round the issue, and apply his powers of comprehension directly to the facts. It is, in principle, this process of gathering knowledge which deputations to responsible administrators of the affairs of a nation profess to aid. Have we a new Home Secretary reasonably suspected of designing some fresh piece of factory legislation? Then it is obviously desirable that he should be

informed at first hand what those who will be affected by such legislation really do or do not require.

At its best, a deputation to a Minister of the Queen is the most trustworthy means that the wit of a practical people has devised for making known the actual opinions of those for whom its spokesmen act as mouthpieces. It is unnecessary to say what it is at the worst. In the course of their day's work, Ministers have to receive all sorts and degrees of deputations, good, bad, and indifferent. Some go for wool, and depart shorn. Some enlighten counsel, others darken it. It is for the Minister to know with whom he has to deal; and the type of man who comes to Cabinet rank in a country of free institutions can generally be depended upon to know more about such things than it is always policy to tell. The present Home Secretary, Sir Matthew White Ridley, was interviewed last week by the deputation organized by the Trade Union Congress; and a strange team they were, with Mr. J. H. Wilson, M.P., at their head, and Mr. Pickard, M.P., at their tail. The speeches on this occasion are worth reading. When the Home Secretary, in the course of his address, said something about the desirability of fostering a friendly feeling between employers and employed, he was interrupted by violent exclamations of dissent, at which he expressed surprise. But what else was to have been expected? If such feelings were to become universal, who would pay the Tilletts, the Pickards, and other independent-of-labour parties, for deputationizing at Whitehall instead of working for their living? Upon one point, it is satisfactory to learn that the Home Secretary is firm. He assured Mr. Pickard that, in any Bill for the amendment of the law of employers' liability which the Government may introduce, they will "at least go as far in the "protection of mutual insurance societies as they did when "they were in opposition." Fortunately, the Government are not likely to repeat the mistake of the last Administration in taking the wire-pullers of the Trade Union Congress at their own valuation, and being willing to perpetrate an act of injustice at their bidding.

Municipal Questions.

Last week, Sir H. H. Fowler, M.P., attended a complimentary dinner given to the Mayor of Wolverhampton; and he took the opportunity for saying some comforting, and not a few trenchant, things about the condition and prospects of English municipalism. He first referred to the movement that has become known as the "municipal "revival"—the most striking sign of which is the widened scope that has been given to the position of Mayor. This is, indeed, one of the most hopeful aspects that has been presented of late years by our local authorities. It is a great thing for England that, as Sir H. Fowler said, there should at the present moment be a Mayor of an English borough who is an ex-Viceroy of Ireland, another who is an ex-Viceroy of Canada, and others who have been either a Viceroy of India or a Cabinet Minister, are peers of the realm, and men of mark in more respects than that of merely possessing an hereditary title. It is not that these distinguished personages can be expected to do much more in the mayoral chair than can the most insignificant townsman called to the same position by his colleagues and equals. The great thing is that they will exhibit in their own persons the operation of that unity of sentiment among all ranks of the people which is the best guarantee for the permanency of the State; and the next greatest thing is that they will help to check the growth of the evil of machine politics in municipal affairs. It is a right and proper feeling that points to the desirability of making fuller use of men of rank and wealth in our scheme of local self-government than that of drawing revenue from them in the shape of rates. Upon this subject of the rates, moreover, Sir H. Fowler made some memorable remarks. He told his audience that the more power English municipalities are entrusted with, the more money they will need. He admitted that the contributories to local treasuries should be increased; and he deprecated the way in which aid to local rates has hitherto been given, under the system of Imperial subventions, upon the ground that this system tends to extravagance. "When local authorities discussed certain classes "of expenditure, they were apt to think, 'Government will "'pay half, and we need only consider how to meet the "'other half.' This was a very natural view to take. But "he held to the doctrine that the power which spent "money should have the responsibility and the discomfort, "it might be, of raising it. Nothing promoted economy, "whether in public or private affairs, so much as the "knowledge of the spender that he would have to find the "money." Include in the term "subventions" the subsidies to rates out of gas profits, and Sir H. Fowler's point is one that has been urged in these columns again and again.

Society of Arts.—The first meeting of the 142nd session of this Society will be held to-morrow evening, when the opening address will be delivered by Major-General Sir J. Donnelly, K.C.B., the Chairman of the Council. Previous to Christmas, there will be four ordinary meetings, at one of which (on Dec. 11) Mr. F. A. Anderson will read a paper on "Water Purification by Means of Iron." Among the papers set down for reading after Christmas is one by Mr. W. J. Dibdin, F.I.C., F.C.S., Chemist and Superintending Gas Examiner of the London County Council, on "Standards of Light."

Management Changes.—Mr. A. W. Elton, the Manager of the Matlock Bath Gas Company, has been appointed, out of 110 applicants, Manager of the Littlehampton Gas Company. Mr. Elton takes with him to the South a good record; for, during the three years he has been at Matlock Bath, the consumption of gas has increased 50 per cent., and the works have been entirely remodelled under his supervision, with the co-operation of the Chairman (Mr. J. Reeds) and the Secretary (Mr. A. Clark).——Mr. G. B. Smedley, jun., a son of Mr. G. Smedley, of Buxton, has received the appointment of Manager of the gas and water works at Beaumaris.——Mr. A. B. Walker, who has been Manager of the Berwick and Tweedmouth Gas Company for the past eight years, has been appointed Manager of the Walker and Wallsend Union Gas Company. Mr. Walker was trained by Mr. G. R. Hislop, of Paisley.

Personal.—Mr. J. Shiress Will, Q.C., who has for some years represented the Montrose Burghs in Parliament in the Radical interest, has intimated his intention of retiring, for entirely personal reasons. Mr. Shiress Will, as our readers will probably remember, was associated with the late Mr. W. H. Michael in the production of their well-known work on "The Law Relating to Gas and Water," the fourth edition of which, issued under the editorship of Mr. Will, includes the law as to electric lighting. He was called at the Middle Temple in 1864, took silk in 1883, and was made a Bencher of his Inn in 1888.——Mr. J. T. Bond, the Chairman of the Water Committee, has been elected Mayor of Plymouth, and also appointed to a vacancy on the aldermanic bench.——Duty has been paid on £39,105, as the value of the personal estate of Mr. C. Overton, of Croydon, son of one of the original proprietors of the Croydon Gas-Works, whose death was announced in the Journal on the 1st ult.——Mr. H. Willis Smith, the Engineer and Manager of the gas-works at Singapore, has been compelled to send in his resignation, owing to the climate being detrimental to the health of Mrs. Smith, whom many of our readers may remember as Miss Agnes Kelman, one of the most popular of the lady lecturers on cookery. Mr. Smith will leave Singapore at the end of March.——The Davy Medal of the Royal Society has been adjudicated by the President and Council to Professor W. Ramsay, F.R.S., for his share in the discovery of argon, and for his discoveries in regard to the gaseous constituents of terrestrial minerals.

Institution of Civil Engineers.—The first meeting of the Institution for the present session was held last Tuesday, when a portion of the new building in Great George Street (comprising the theatre and approaches, with tea-room, &c.) was made available for the purposes of the evening. The chair was taken at eight o'clock by Sir Benjamin Baker, K.C.M.G., LL.D., F.R.S., the new President, who delivered his Inaugural Address. After some preliminary observations referring to the position of the Institution in the domain of engineering, and the necessity of British engineers acting together in a true spirit of comradeship throughout the world, the President proceeded to discuss the question why engineering, unlike other liberal arts, was an essentially modern profession. Towards the close of his address, the President dwelt upon the work done by physicists in the borderland of engineering; and he expressed the opinion that, long before the coal-fields were exhausted, some way would have been discovered of tapping the inconceivably great reservoirs of force in Nature still untouched. In conclusion, the President sounded a note of warning against the growing disposition to overrate technical education. Education would, he said, do much; but it would not endow a man with common sense, nor would it make his opinion on a multitude of important subjects worth more than that of any naturally observant person. There were contractors and manufacturers who contended that some of the highly-trained young engineers of the present day were no wholly free from a tendency to over much reliance on formulæ,twithout due regard to the sufficiency of the data upon which the se were based. Such faults were best remedied by joining in practical discussions with other engineers, such as it was a province of the Institution of Civil Engineers to encourage. After the delivery of the Address, the President presented to the recipients or their representatives the medals and premiums awarded for papers read last session or printed in the Proceedings.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 1052.)

LAST week was an intensely exciting one for the Stock Exchange. No one could tell what might be the state of things at the end of it. But it has come and gone; and the markets breathe much more freely at the close than at the opening. The settlement was got through a great deal better than had been expected. True, eight unfortunates have been hammered. But then they were not of much importance (except to themselves); and, as it was manifestly impossible to save all, perhaps the fittest have survived. At all events, they have been helped to live a little longer. A good many people have been taught a salutary lesson upon plunging which will last them—till they forget it; and then they will plunge again. The recovery in prices has been universal, from Consols downwards; and they exhibit a striking contrast with the figures they cut a week ago. The Money Market was firmer; and good rates were created by the requirements of the Stock Exchange. During this agitating period, business in the Gas Market has been quiet and unemotional; transactions on the whole being considerably below the average. The general tendency is to firmness at something like the existing figures, despite the weakness of a commanding stock. In Gaslights, the "A" was fairly active in the earlier portion of the week at about middle prices, afterwards relapsing into inactivity. But the latest prices at which business was done were the best of the week; and, in fact, the best obtained in the last three weeks. The secured issues were brisk, and very strong, realizing high figures. The "C," "D," and "E" 10 per cent. preference changed hands on Wednesday at 288, which, we believe, is a "record" price. South Metropolitans were not particularly active; but prices tended to be a little better, especially for the "A" stock. Commercials were quieter; but a few parcels of the old stock changed hands, and 324 was obtained more than once. There was scarcely anything doing in the Suburban and Provincial division; but Alliance and Dublin old made a slight recovery. Crystal Palace was done as high as 130. Among the Continentals, none was conspicuous but Imperial, which fell away until it dropped a couple of points *ex div.* The rest presented nothing calling for special remark, except Monte Video, which had a slight relapse. The Water Companies moved somewhat irregularly. New River was freely offered, and dropped 5; and East London and Lambeth were weaker. But Chelsea and Kent were firm.

The daily operations were: On Monday, business in Gas was moderately active, mostly in Gaslights; the secured issues being specially strong. "C," "D," and "E" rose 1½. East London Water fell 3. Transactions on Tuesday were more restricted; but prices, on the whole, were very steady. Monte Video was ½ lower. In Water, New River receded 5. Business in Gas grew quieter still on Wednesday; and quotations did not move. In Water, Chelsea rose 1; but Lambeth tens fell 1. On Thursday, prices for Gas stocks were good, except for Imperial Continental, which dropped 2. Alliance and Dublin recovered ½. Business was quiet on Friday; but prices held up steadily. Saturday's transactions were very limited; and quotations closed without further change.

ELECTRIC LIGHTING MEMORANDA.

The Electric Lighting Affairs of the St. Pancras Vestry—The Cause of the Dearness of Electric Light—An Old Expedient Revived.

ANOTHER official publication has been issued by the St. Pancras Vestry concerning their electric lighting undertaking, in the form of a report by the Chief Clerk (Mr. A. E. Pycraft) on the work of the Electricity and Public Lighting Department during the year ending May, 1895. This period covers a great extension of the undertaking, as well as the introduction of the five-wire system of distribution, by which it is claimed, among other advantages, that current can be distributed at a pressure of 440 volts, and therefore, if desired, the public street-lamps could be supplied from the private lighting mains. Up to the end of May last, there were 373 consumers on the books; representing 16,751 incandescent lamps of 16-candle power, 129 arc lamps, and 27 motors aggregating 103½-horse power. It is noteworthy that the Vestry do not adopt the principle followed by the Metropolitan electric lighting companies, of expressing the number of lamp-connections in terms of the so-called standard 8-candle lamp. So far as this report shows, the 8-candle lamp is not much used in St. Pancras; the chief business done being in supplying 16-candle lamps. The total cost of generating a unit of electricity during the year 1894 is stated to have been 5·053d., which includes generation, distribution, management, and interest and repayment of loans, but not depreciation. Reference is made in the report to the culvert explosions in the vicinity of the Euston Road, which are ascribed to coal gas; and it is observed that the Vestry, having carried out Major Cardew's recommendations as to conduit ventilation and protection at considerable expense, it now remains for them to "consider what action should be taken against The Gaslight and Coke Company to compel them to keep their mains in such a condition as to prevent leakage of gas into the Vestry's culverts, as well as the question of recovering the cost of the works carried out; as, both the Company and the Vestry having legal statutory rights to lay mains in the same thoroughfares, it is manifestly unjust that the Vestry should be required to carry out works necessitated by the negligence of the Gas Company." We were under the impression that the works in question were necessitated by the negligence of the Vestry; but this point may be passed over until such time as the Vestry may take steps to have the "legal and statutory" rights of the question determined by the proper authority.

An article on reducing the cost of electric light appeared some months back in the *Engineering Magazine;* and since the conclusions of the writer (Mr. Nelson W. Perry) have gone uncontradicted, they may probably be taken as not far from the truth of the matter. He declares that it is so easy to prove on paper, by means of apparently legitimate assumptions, that the electric light can be made to sell at a considerable profit at a figure which is but a fraction of that usually charged, that the public have been "easily convinced that a bonanza attended the procurement of an electric lighting franchise in almost any municipality." Unhappily, "the rude awakening to the investor when the annual statement has shown a balance on the wrong side of the ledger, in the face of the brilliant promises held out by lead-pencil prophecies," has brought the electric lighting industry into disrepute. Mr. Perry sets himself to disclose the reason for the disagreement of promise and fulfilment in the industry; and he finds it where other inquirers have found it before him—in the variable load-factor of central lighting station experience. He develops the point, however, to an unusual extent, with a view to show that electrical engineers who might be supposed to be well posted in this regard seldom understand its full bearings. It means, in the first place, an altogether disappointing return for the fuel consumed in generating current; and, secondly, it seriously affects the capital charges, which are sometimes of more importance than the coal bill. "It is these," he observes, "which so often render the employment of water power uneconomical, and which must militate so largely against the economical results from the great Niagara electrical power scheme." Again, as to the cost of distribution, Mr. Perry states that "probably nine out of every ten to whom the question was propounded would answer unhesitatingly that energy for lighting purposes could be delivered more cheaply at a distance by electrical means than by gas transmission; and, under some conditions, this is true. But I find by calculation that, if the distance involved were a mile, it would require considerably more metal to supply the electric lights by means of the direct current than would be required for pipes to convey a supply of gas for the same number of lights with the same efficiency of transmission." He confesses, therefore, that the bane of the electric lighting industry is the peculiar service which it is required to supply, with its uneconomical load factor. Mr. Perry does not see how to escape from this trouble by the way of encouraging a heavier day load, because anything of the kind must of necessity overlap the lighting load during the winter season. In the same unhopeful spirit he discusses the Brighton system of charging for current, and suggestions for manufacturing some bye-product of the electrical machinery during the hours of light load. His ultimate conclusion is that "the demand of the day therefore is not better dynamos, better engines, or better methods of transmission, but steadier jobs for the apparatus we have; and he who will invent that job will do a better service to the electrical industry than he who invents a new electrical system." There is nothing at all novel in this opinion; but it goes to confirm the belief of those who hold that there is no present prospect of any considerable cheapening of the electric light by improvement of the lamps or any other part of the equipment of a central supply undertaking.

For the reason given in the foregoing paragraph, it is possible to read with equanimity the claims that have been recently advanced in certain newspapers on behalf of the Jandus "semi-incandescent" arc lamp. This wonderful apparatus has been promised to "prove itself in electric lighting as distinctive a competitor as the Welsbach light in the gas lighting industry"—whatever this confused statement may be intended to mean. It is further stated that "the new lamp is the result of prolonged and costly experiment. A period of eight years, and a sum approaching £30,000, have been consumed in bringing a theory into practical utilization." In a general way, when an article is "puffed" in this style in the newspaper press, one knows what to expect, since really good things are offered for sale for what they are worth, not for what has been spent in putting them upon the market. The case of the Jandus lamp appears to be no exception to the rule. It is an arc arrangement enclosed in a double globe; the idea being that when the arc is started it will use up the oxygen contained in the enclosed space, and thereafter nothing but carbon monoxide and nitrogen will remain, in which event, of course, the carbon rods will not burn away. It would be difficult to say how many times this plausible idea has been taken in hand by would-be improvers of the arc lamp in the direction of giving increased durability to the carbons, since Mr. Henry Woodward took out a patent for a lamp on this principle so long ago as 1876. We do not, at

any rate, anticipate any marked revulsion of feeling on the part of the people of this country in regard to lighting by the electric arc, from the appearance of a lamp which, instead of combining the advantages of the arc and incandescent principles of electric lighting, is more likely to fail to realize either.

IMPROVEMENTS AT THE HUDDERSFIELD GAS-WORKS.

The Huddersfield Corporation Gas-Works just now present a more interesting aspect to the engineer visitor than has been the case for many years; and therefore we judge the time opportune for the publication of a short account of what the Engineer and Manager, Mr. W. R. Herring, has recently been doing with a view to bringing the establishment up to date. We are indebted to Mr. Herring himself for the heads of the information contained in this article, as well as for the photographs from which illustrations appearing on pp. 1032-3 are reproduced; but it should be understood that Mr. Herring is not responsible for the shape in which the information in question is conveyed to our readers, and also that the comments we have to offer upon the works and their equipment are our own.

With this preamble, we venture to commence our observations with the statement that the condition into which the Corporation of Huddersfield had allowed their gas-works to sink when the present Engineer and Manager was appointed to take charge of the undertaking, would constitute an object-lesson to illustrate and confirm the truth of everything we have had to say at different times respecting the ineptitude of municipal gas administration. The works had simply been starved, in order that the rates of the town might be spared. We are not in a position to state just now precisely how much money the gas-works have been forced to contribute to aid the municipal treasury; but the salient features of the situation in which Mr. Herring found himself when entrusted with the sole responsibility for keeping up the supply of gas to the district, are no secret to our readers. The works were utterly incapable of producing the output of gas demanded; they were destitute of every modern facility for economically producing and purifying such gas as they could supply; and nothing had been done to reduce the onerous capital burden which kept the supply dear, and rendered the prospect of having to make costly improvements and extensions a truly formidable one. Just in time, however, and only just, a new spirit entered into the Corporation Gas Committee. Mr. Alderman Stocks was elected Chairman of the Committee; and to him more than to any man living in Huddersfield to-day is it due that what should have been a splendid piece of corporation property—and will yet become so, in a few years' time—is not now a discredited concern, only existing by virtue of an Act of Parliament. For the present, the large sums of money that have been expended by the Gas Committee in carrying out Mr. Herring's plans for remodelling and modernizing the works, have made this body a mark for much ill-informed local cavilling. We trust to be able to show, however, that if the people of Huddersfield have only themselves to thank for the existence of the arduous conditions as regards the burden of capital under which the improvement of their gas-works has to be effected, the money is being spent to advantage, so far as the carbonizing department of the works is concerned; and the new improvements are bound to pay for themselves in a short period of time.

Mr. Herring has himself told how he first introduced the inclined retort system of carbonization into Huddersfield. [See Journal, Vol. LXIV., p. 419.] Although the application of the system in this first instance was hampered by local difficulties—such as the absence of a stage-floor retort-house, and so forth—yet its success was such as to determine Mr. Herring to recommend its extension under conditions more favourable to the realization of the best results. The advice was taken; and the suitable conditions were prepared by the erection, upon the site of one-half of an old retort-house destitute of all reason for being preserved, of a fine, boldly-conceived retort-house, not merely of one but of several stages, and measuring 86 feet wide in the clear inside. When completed to the full length permitted by the site, this house will be 350 feet long; and it will then accommodate sixty settings of nines. At present, but one-half of the house is finished, including the tall, handsome chimney which has been erected to serve the steam-boilers, and is also used for the retort-furnaces. In modern gas engineering practice a tall chimney for a retort-house is regarded as a superfluity likely to do much more harm than good. But in Huddersfield, the gas-works are in such a position as to necessitate a lofty chimney, in order to carry the products of combustion above the level of the high ground in the neighbourhood. The chimney is built in two entirely separate skins of brickwork—the outer of ordinary bricks, built in octagonal form; and the inner, in a circular ring of fire-bricks of the same diameter from top to bottom. The annular space between the two is ventilated by air-inlets at the base and outlets at the top. The inner fire-brick ring strikes the inner lining of the outer casing about 20 feet from the top, owing to the "batter" of the latter; but it is in no way connected with it. The portion of the chimney in direct contact with the heat is thus free to expand, both laterally and vertically, without causing the least stress upon the chimney-shell.

The new retort-house, like every other building in Huddersfield, is of stone; but as the foundation was none of the best, it was desirable to lighten the weight of the walls as much as possible. To effect this, and yet obtain the necessary headroom, Mr. Herring adopted the device of covering the retort-house with a semi-circular girder roof, which, being glazed at the crown, gives a particularly light and airy appearance to the whole structure. The girders are absolutely self-stayed, throwing no side stress whatever upon the walls, to which they are anchored by means of holding-down bolts. A light wall is carried up above the springing of the girders, and carries the ends of the straight secondary roof-girders; the ventilated spandril space between the top of the main girders and the actual roof covering being made to accommodate the primary condensing mains, which consist of five lines of 18-inch piping. The secondary condensing mains, consisting of two lines of 24-inch tubing, are suspended from the inner side of the roof girders. The chief object of the secondary condenser is to encourage the final deposition here of all aqueous and tarry matters, by reason of the slower travel of the gas through the enlarged area of the tubing. The retort-house building is a very creditable architectural effort; being, as all such structures should be, plain, substantial, and well adapted to the purpose it is intended to subserve.

The carbonizing plant installed in this house consists of a double range of inclined 15 feet taper retorts. The middle or charging stage is 22 ft. 6 in. wide; and each drawing or discharging stage is 18 ft. 10 in. wide. These widths are found to be ample. Inasmuch as coal elevating and conveying machinery is as integral a part of the system of carbonization as the retorts themselves, the house is provided with several floors, or stages, to facilitate the use of such machinery. On the ground floor, which is the stoke-hold, run tip-waggons on a tram-line, so disposed that they receive the coke as it falls from the stage above. Here likewise the furnace-doors are found. On the first stage stand the men who open the retort discharging lids—placing in front of them a traversing screen which directs the coke into the basement. When we saw these retorts at work, they had only been in operation for a few days; the new plant having been provided for the needs of the coming winter. It was thus too early to say much about the carbonizing results. We can, however, testify to the satisfactory charging and discharging of the retorts, which, of course, is the main thing.

The settings, as already stated, are nines; and the difficulty of the ascension pipes is met by making two pipes upon each setting take two mouthpieces—the size of pipe being enlarged accordingly. Thus there are only seven ascension pipes for every nine retorts. The dip-pipes are hydraulically sealed in liquor; the tar being automatically drained out of the main. Particular care is taken to ensure the staunchness and durability of all the retort-fittings, to which end the weight of the retort ironwork is supported independently of the retorts.

The charging is effected from a second-floor stage, occupying the middle space between the benches. The coal, stored in overhead hoppers, kept full by push-plate conveyors travelling ten hours a day, falls from these into measuring chambers, which can be regulated to any desired weight of charge, and are then locked up. When a retort is charged, the measured quantity of coal is released by a lever, and falls into the shoot which directs it into the mouthpiece. To the bottom of every measuring chamber is fitted a Graham's patent balanced flap, which prevents any possibility of tampering with the quantity of coal put into the retort. It has been found that, where the simple "shot-pouch" device for charging the retort is employed, it is within the power of the operator to allow much or little coal to pass into the retort at will; but Mr. Graham's attachment obviates this completely. It is merely a counterbalanced flap, which, being so placed as to receive the impact of the descending charge, will not allow any of it to escape until the whole is through the measuring chamber, when it opens, and so prevents the shutter of the charger being pushed in again until the whole charge has gone into the retort. It is an invaluable check upon the operator, if he is disposed to be tricky. One smart lad to charge, and a couple more to see to the lids and traverse the coke screen below, complete the working staff engaged upon the stages.

A word must be devoted to the coal elevators and conveyors, which are as complete as they are simple. All coal has to be carted into the works at Huddersfield; and the carts tip their loads at the top of a shoot which will convey the coal to the mouth of one of a pair of crushers. Thence one of a pair of elevators will take it up to the top level of the system, where it can be diverted to either or both lines of push-plate conveyors commanding the service hoppers, which are designed to take about 14 hours' supply. All the elevating and conveying plant is in duplicate, to guard against risk of breakdowns; and it has been the Engineer's aim to make the whole plant as nearly as possible self-regulating and automatic. As an indication of the care with which Mr. Herring has worked out his plans, it should be mentioned that his buckstaves are fitted with hinged brackets of T iron, which are available instantly for supporting a couple of planks or a bar should any work be required to be done upon the front of the settings. The contractors for the carbonizing plant at Huddersfield—inclusive of the elevators and conveyors—were Messrs. Little and Graham, Limited, of London, who have done their work well and punctually.

Finally, it may be noted that a new oil-gas plant has been

put down to Mr. Herring's latest design, which (in conjunction with the oxygen process) is employed to carburet the common coal gas produced throughout the works. The amount of enrichment supplied in this way is 2¼ candles; and this is stated by Mr. Herring to have been accomplished, during the past twelve months, at a cost of one-fifth of a penny per candle per 1000 cubic feet—including oxygen and royalties.

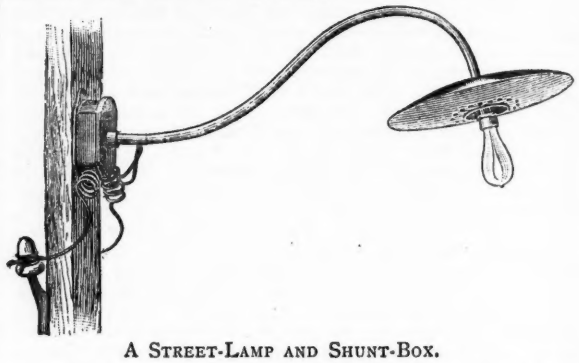
AMERICAN VIEWS OF PUBLIC LIGHTING SYSTEMS.

A USEFUL article upon "The Illumination of Streets and Public Places," by Mr. Franklin Leonard Pope, has appeared in the *Engineering Magazine*. Its utility consists chiefly in the freshness with which the writer discusses the problems of street lighting which, though partly solved for the United Kingdom in our grandfathers' time, are nowhere completely disposed of by a consensus of practice even at the present day. Such examples as that of Wimbledon are constantly coming under notice, to prove that the fundamental principles of public lighting are by no means generally understood, even in localities the inhabitants of which would consider themselves grossly insulted if they were accused of being behind the times in this or any other respect.

Mr. Pope commences with a reference to the lighting of villages—remarking that in the United States, when a neighbourhood has become of sufficient importance, in the estimation of its inhabitants, to justify the provision of a sidewalk and two or three street-lamps by voluntary public subscription, it has advanced to the status of a village; while the introduction of gas or electric lighting in its streets and places of business ought to entitle it to the distinction of being called a town. Strictly, village public lighting is properly a matter of petroleum lamps. Of the reasonableness of this view of the necessities of the case, and the best way of satisfying them, there can be no doubt. We agree with Mr. Pope that there is now a disposition to underestimate oil-lamps as means of public lighting; people tending to go to the other extreme, and call for the electric lighting of localities that have never enjoyed any public lighting at all. It is not so well appreciated as it ought to be that oil-lamps, when properly installed and intelligently managed, are capable of furnishing a really excellent lighting service at moderate expense. Upon this head, Mr. Pope states that "lanterns are now so constructed that the enclosed lights are not materially affected even by violent winds and storms; while by the use of oil, wicks, and chimneys of the best quality, and by conscientious care in cleaning and trimming, results may be attained little, if any, inferior to those usually realized from gas and electricity." He is also right in urging that, when village lighting is attempted, the common mistake is made of installing too few lamps, and not fixing them sufficiently high above the ground. He estimates that, in a country town of average compactness, it may be estimated that one lamp to every twenty-five inhabitants will be found sufficient. The most economical and satisfactory plan for maintaining oil street-lamps is "to put the whole matter in the hands of a single responsible person, who should be able to clean, fill, and trim eight or ten lamps per hour, and to light twenty-five or thirty in an equal period of time." For village communities, public lighting is not required after midnight nor during the four or five nights of full moonlight. The efficiency of the whole system, however, depends upon the quality of the attendance and supervision, and its effectiveness upon the number of lamps erected. Seeing that the cost of attendance bears a high proportion to that of the lighting material and repairs, the provision of the few lamps more, which makes such a difference to the general effect, is, or should be, a small consideration.

Mr. Pope asserts that, before the advent of electric lighting, the public gas-lamps in common use in United States towns were both costly and unsatisfactory. The average price charged for the gas supplied to the public lamps was as high as $2, or 8s. 4d. per 1000 cubic feet; while the regulation 5 cubic feet per hour seldom gave more than a 10 or 12 candle power flame. "Widespread dissatisfaction with the results of public gas lighting existed in the community, which was often due, it is but fair to say, in no small degree to the absence of proper care and inspection on the part of the municipal authorities. This feeling of dissatisfaction had the effect of hastening the adoption of electricity for public lighting in many of the larger towns of the United States, within a very short period after the necessary apparatus had been placed upon the market in a commercial form." In support of this observation, the writer offers the following contribution to the history of street lighting: "The first attempt to illuminate a town by electricity was made at Wabash (Ind.), in March, 1880. Arc lamps were used; two being placed upon the tower of the Court House, and two more on a mast erected for the purpose. The trial run was visited by hundreds of visitors from all parts of the country. The plant, consisting of four lamps and the dynamos, is said to have originally cost $18,000. It has operated continuously for six years, after which it was taken down and ultimately sold for $30 as a historical curiosity." When Mr. Pope speaks of the "first town" lighted by electricity—to the extent of four arc lamps—he refers, of course, to American examples only; for the application of the same means of public lighting to European and English city thoroughfares upon a much larger scale dates back to 1878, the then pioneers of this development—Jablochkoff, Werdermann, and others—having been working and experimenting in this direction for some years previously.

Mr. Pope goes on to remark, very sensibly, that the first arc lamps employed for street lighting in the States were denominated 2000-candle power lamps—"a meaningless and deceptive rating enormously in excess of their actual illuminating power, which, as recent investigations have shown, seldom exceeds one-fourth that amount." It is incontestable, however, that to the "happy thought" of the individual who first applied this denomination to electric arc lamps is due the remarkable success of electricians everywhere in obtaining street lighting contracts at prices greatly in excess of the previous charge for gas; and the useful imposture is not yet abandoned. Mr. Pope admits that, for all the hundreds of thousands of electric arc lamps that have been used for public lighting during the past fifteen years, "they are by no means so well adapted to that purpose as their extensive use would lead one to suppose." A full-sized arc gives, he admits, a brilliant and showy light, so that a row of them imparts "a decidedly metropolitan aspect" to the streets of a small town or an ambitious suburban village; and it is shrewdly suggested that it is for such reasons that the popularity of the arc lamp has always been greater than its intrinsic merit would seem to justify.



A STREET-LAMP AND SHUNT-BOX.

Mr. Pope describes the method of generating the arc light, in order to explain the unevenness of its distribution. "Directly beneath the lamp is always a circular dark shadow 30 or 40 feet in diameter; encircling this is a zone of brilliant light, the maximum intensity of which is found at a horizontal distance from the vertical axis of the lamp equal to its height above the ground. Beyond this zone of maximum illumination, the effective light rapidly diminishes, until, at a distance of some 300 feet, it is merged in the surrounding darkness." As very commonly applied to the ostensible purpose of lighting streets, such a system is worse than no light at all. "The alternate areas of intense light and opaque shadow, and more especially the blinding glare of the arcs themselves when viewed at certain angles, frequently render it impossible for either horse or driver to discern an obstruction until too late to prevent an accident." This consideration led to the suggestion of "tower lighting," which Mr. Pope says was at one time "quite in favour," especially in Western cities having broad streets with few high buildings or shady trees. The best example of this arrangement, now obsolete, was once afforded by the City of Elgin, Illinois. Here the central tower was 150 feet high, and carried five lamps. It was surrounded by six other towers, each 125 feet high, carrying four lamps. The towers were, roughly speaking, located something like half a mile apart. In this case, the area "lighted" was about four square miles; the population numbered about 16,000.

Mr. Pope observes that the standard arc lamp for street-lighting purposes—the traditional 2000-candle power lamp—operates with a difference of potential between its terminals of from 45 to 50 volts, and takes a current of from 9·5 to 10 ampères; so that the energy expended in each arc is approximately 0·6 of a horse power. The smaller type of arc lamp, nominally of 1200-candle power, which has an extensive sale and some popularity, "especially in ambitious communities of an economical turn," does not recommend itself to Mr. Pope, who confesses his inability to see, as an electrical expert, where its supposed economy comes in. It takes only 6·8 ampères of current. But the lighting effect is unsatisfactory—the falling off in this respect being considerably greater than the proportionate saving of fuel at the central station, and every other expense of erection or working is the same as for the full-sized arc. The alternating arc he does not like at all, and does not think it will ever become popular; being noisy, and wasteful of current for the light produced.

Lastly, Mr. Pope bears testimony, in a manner that should encourage the Wimbledon enthusiasts, to the promise of the series incandescent system, which he ventures to think will meet with general adoption for street lighting in all except possibly the very largest cities and towns. "Under the conditions which are met with in most localities, experience indicates that the lamps should not be less than 20, and need not be

more than 32 candle power to combine economy and good distribution of light. In most cases, a 25-candle lamp, if run at its full rated voltage, will be found to give excellent results." In order that the full value of this testimony to the beauty and economy of incandescent electric street lighting may be appreciated, we have given on the previous page an illustration, taken from Mr. Pope's article, of the "plain, neat type of fixture" for this method of lighting, which he placidly recommends as "perhaps as good as any." It is made of ¾-inch gas-pipe, curved into a goose-neck, and screwed into a cast-iron socket upon the supporting pole. The lamp is set into a protecting sheet-metal hood, and fitted with an annular convex reflector. "Such lights ought to be located at intervals of from 250 to 300 feet, which in the central district of the town may be reduced to 125 feet. Along suburban roads, lights 350 to 400 feet apart will often serve the purpose sufficiently well." This must be a pleasing prospect for the denizens of such suburban neighbourhoods as Wimbledon.

We have given prominence to Mr. Pope's article and to his recommendations in respect of public lighting by means of incandescent electric lamps, in order that we may not be accused of keeping our readers in ignorance of the best that can be advanced on behalf of the system by those American practitioners who are so much more "advanced" in such matters than the benighted people "on this side." Of course, it is open to anybody to argue that Mr. Pope's ideas of what is seemly in a public lighting service are crude to the verge of the barbarous; but it must be remembered that the "neat poles," the "lines of thin, black-coated wire," the "goose-neck of gas-pipe," and the rest of the appurtenances of the system he advocates so artlessly, are identified with the possibility of getting the lighting service at anything like the price he estimates, which is from $20 to $24 per lamp per annum—say, £4 3s. 4d. to £5 per point. It is quite in the true electrical apologist's vein that Mr. Pope urges that "a 25-candle lamp will give in practice from twice to three times as much effective light as the average gas-lamp *formerly* found in the public streets of our cities and towns." When will gentlemen of his persuasion awake to the necessity of making their account with the latest and best, instead of the worst and oldest competitors in the shape of gas-lamps? It is very certain that the general public, to whom purveyors of every kind of light must look for support, are not so astigmatic of vision as most of those who pose as their leaders in such matters, so far as they may be supposed to require leading in the direction of the realm of electricity.

The Preston Carburetted Water-Gas Plant: A Correction.—In the account of the Preston Gas Company's Moor Lane station published in the JOURNAL for the 5th inst. (p. 918), it is stated that the Humphreys and Glasgow carburetted water-gas plant in course of installation at these works is rated to manufacture 135,000 cubic feet of gas per day. By inadvertence, a cipher was dropped from this figure, which should read "1,350,000 cubic feet." We regret the error, which, if uncorrected, might be the means of spreading a false impression as to the producing capacity of this example of Messrs. Humphreys and Glasgow's speciality.

Carbon Compounds of the Metals of the Rare Earths.—Carbon compounds of some of the rarer metals have been prepared recently by Herr O. Pettersson (*Deut. Chem. Ges. Ber.*, 1895, Vol. XXVIII., p. 2419) by reduction of the oxides electrically. The dried oxide, best prepared by ignition of the oxalate, is mixed with finely powdered charcoal, and the mixture is submitted to the electric arc from a current of 60 volts, and 45 to 100 amperes. There were thus obtained carbides of lanthanum, yttrium, cerium, and niobium. They are crystalline bodies, brittle, and yellow in colour. A newly-exposed surface rapidly becomes covered by a thin grey film of oxide, and loses its metallic lustre. It is not stated what gas is evolved when these carbides are decomposed by water. Heated in a stream of hydrochloric acid gas to a bright red heat, the carbides are converted to the neutral chlorides, which volatilize. In their general behaviour, these carbon compounds resemble the calcium and aluminium carbides.

Profit-Sharing.—One of the first gas companies to follow the lead of the South Metropolitan and Crystal Palace District Gas Companies in adopting the system of profit-sharing is the Columbus (Ohio) Company. We learn from the following paragraph, taken from *Employer and Employed* (a Boston publication) for the past month, that at the meeting of the Directors of the Company on July 23, "they authorized the adoption of the plan for profit-sharing recommended to the Company at the March meeting by President Emerson M'Millin. The dividends will be based on the amount of their pay during the period for which the stock dividend is declared for stockholders, and in the same per cent. At present the dividend is 5 per cent., payable semi-annually at the rate of 2½ per cent. The conditions imposed are that the employees are to receive scrip exchangeable for stock until their holdings amount to $300, when it is optional whether they take cash or scrip. A further condition is that the profit-sharing applies to men more than a year in continuous service. The next dividend under the plan will be in November, when it will be paid to stockholders and employees alike for the six months ending Oct. 1." This matter was mentioned at the recent meeting of the American Gaslight Association.

NOTES.

Oxide of Iron Paint and Sulphuretted Hydrogen.

In connection with the subject of the preservative painting of ironwork and recent articles in the JOURNAL upon the subject, it is of interest to note that Mr. Henry Green, the Engineer and Manager of the Preston Gas Company, has a special way of preparing the paint used in the gas-works under his control from the after-effects of sulphuretted hydrogen. He simply exposes the paint paste, composed of natural oxide of iron and linseed oil, to the action of sulphuretted hydrogen before it is thinned down for use. This is effected by burying the paste, in pots, in the oxide of iron purifier attached to the sulphate of ammonia plant, until the sulphuretted hydrogen has had all the effect upon it that is possible under these highly favourable conditions for chemical action. After this, nothing further of the same kind of influence can hurt the paint, which exhibits no other alteration of character from the treatment than a slight darkening of colour. Mr. Green was led to adopt this expedient by observing that when oxide paint is used in gas-works, sulphuretted hydrogen is certain to get hold of it sooner or later; and he has found, from many years' experience, that, after well seasoning the paint in the manner described in the first instance, no deleterious after-effects are to be feared.

The Uniformity of the Carbon Arc Crater.

Professor J. Violle is unremitting in his endeavours to obtain a reliable standard of light. His performances with solidifying platinum having turned out hardly even a *succès d'estime*, he has directed his attention, with more hopeful prospects, to the phenomena of the electric arc as offering a means of establishing a standard of light upon a sound basis. Having ascertained by previous experiments that the brilliancy of the crater in the carbon arc is the same for currents between 10 and 400 amperes, Professor Violle was desirous of making this assurance of constancy doubly sure by experiments with currents of 1000 and 1200 amperes. The desired corroboration was obtained; the intrinsic brilliancy of the carbon crater being "rigorously constant at every range, from 10 to 1000 amperes, and from 110 to 75 volts." Photographs in evidence of these conclusions were shown by Professor Violle at an exhibition of the French Physical Society. These photographs showed images of two arcs, taken upon the same plate, one over the other. One was of an arc of 10 amperes and the other of an arc of 1000 amperes; and they were photographed by white, red, and green light—the plates being developed all over in exactly the same manner. The reproduction of these photographs, published by the *Electrician*, certainly indicates that Professor Violle is justified in his contention that the light emitted from the crater of the carbon arc is equally brilliant under all conditions of current, from which it would follow logically that a known unit of area of the crater would always supply a standard of light, if the carbons could be relied upon, and there were no other objections to the method.

A Chain Rule for Testing Boiler Data.

In a recent letter to *Engineering*, Mr. W. B. Muserling, of the Hague, Holland, offers a valuable commentary upon the published results of Dr. Kennedy's and Mr. Bryan Donkin's steam-boiler tests. He points out that the principal data relating to the working of any steam-boiler are: 1, Pounds (*a*) of coal (lb.C) burnt per hour per square foot of firegrate surface (G.S.). 2, Ratio (*b*) of boiler-heating surface (H.S.) to firegrate surface. 3, Pounds (*c*) of water (lb.W.) evaporated per hour per square foot of boiler-heating surface. 4, Pounds (*d*) of water evaporated per pound of coal. These four quantities are closely connected with one another; and their necessary connection is most clearly shown by the "chain rule." According to the method of writing this rule, we have—

lb.C.	a	1	G.S.
G.S.	1	b.	H.S.
H.S.	1	c.	lb.W.
lb.W.	d	1	lb.C.

$$a\,d = b\,c$$

This simple equation, Mr. Muserling observes, ought to be always used for controlling the chief data which have to be considered when designing a steam-boiler. The method was introduced, and has been for many years taught by, Professor A. Huet, in his course of lectures on machine design at the Royal Polytechnic School of Delft. The equation also gives a check upon the experimental data obtained from boiler trials. Mr. Muserling accordingly applies it to the data of Mr. Donkin's summary (*ante*, p. 777). Taking for example the data deduced from the East London Water Company's Cornish boilers with Galloway tubes, the figures would appear in the chain rule as follows:—

lb.C.	15·7	1	G.S.
G.S.	1	19·3	H.S.
H.S.	1	7·43	lb.W.
lb.W.	9·16	1	lb.C.

$$143{\cdot}81 = 143{\cdot}40$$

The greater number of the experiments have led to exact results, which proves their reliability within the limits imposed by experimental errors.

Mr. A. L. Steavenson on Boiler Duty.

Commenting on the subject of the preceding communication, of which he professes admiration, Mr. A. L. Steavenson, of Durham, observes that the method admits of a little extension. Applying it to Mr. Donkin's list of Lancashire boilers, and comparing the pounds of water evaporated per pound of coal with the ratio of heating surface to firegrate, we get an average of 1 lb.C to 12·43 lbs.W, with grate surface and heating surface of 1:44·6; and 1 lb.C.to 9·97 lbs. W. with a ratio of grate to heating surface of 1:38·8. This shows very clearly the benefit of the larger ratio of heating surface; and it leads Mr. Steavenson to remark upon the great quantity of statistics which are available upon boiler "efficiency" compared with boiler "duty." He says he has been looking into the matter for some time, and is surprised at the fewness of the writers who treat of the question, "What should a boiler do, when working at its best—meaning both capital involved and working efficiency?" Take for example a Lancashire boiler 30 feet by 8 feet. This will evaporate, according as it is pushed, any quantity of water up to 80 tons in 24 hours from 200° Fahr. Mr. Steavenson knows of some which are actually doing nearly this amount of work, and others of the same size doing less than half of it. The latter give the higher efficiency, and no wonder; for their gases leave the boiler at a temperature which hardly exceeds 500° Fahr., while in the others the temperature at the same point is 1150° Fahr. Mr. Steavenson declares that this question of final temperatures has been almost entirely neglected; and he puts the question of how many boilers are needed to supply, say, 2000-horse power? Five 30 feet by 8 feet Lancashire boilers would do it, if pushed to the top limit of 400-horse power each, which means an evaporation of 80 tons of water in 24 hours. But Mr. Steavenson considers that it would be more economical in the long run to have six or seven such boilers, and work them quietly, having regard to the point of final temperature.

Magnesite Fire-Bricks.

The familiar makes of fire-brick are threatened by a new kind of refractory material occurring on the coast of Eubœa, Greece, in the form of magnesite ore—a dazzlingly white stone, which is actually being largely worked by a French company. The ore is shipped both crude and calcined; being eminently suitable for lining furnaces. It is also used for certain purposes as a substitute for china clay. The most promising application of the material, however, is the making from it, after grinding and calcination, of fire-bricks by machinery. These bricks are fired at a great heat by Siemens gas-furnaces, using a local lignite for fuel. They are reputed to stand extremely high heats for a long period. Their composition is guaranteed to be 95 per cent. of pure magnesia; analysis frequently giving the purity as high as 97·80 per cent. Magnesia powder is shipped from the same locality to lay the bricks with. The magnesia bricks are somewhat high-priced; but this will not be a serious hindrance to their coming into extensive use in the arts if the material is really better for the construction of furnaces (to say nothing of crucibles and retorts) than the commoner materials employed for these purposes.

The "Engineer" Road Carriage Competition.—Particulars in regard to this competition, to which reference has already been made in our columns, are now furnished in the *Engineer*. The competing vehicles are to be divided into four classes; and the prizes will be 150, 250, 250, and 350 guineas. The trials are to consist of a run of 200 miles out and home; the speed not to exceed ten miles an hour. The weight of the carriage is limited to two tons. The Judges are to be Sir F. Bramwell, Bart., F.R.S., Mr. J. A. F. Aspinall, M.Inst.C.E., and Dr. Hopkinson, F.R.S.

Laying Pipes under Water.—At a recent meeting of the Engineers' Club of Philadelphia, Mr. W. H. Dechant read a paper on "The Submerged Pipe-Line for the Pennsylvania Sanitary Sewerage Company, at Reading (Penn.)," in which he fully described the method of constructing the submerged pipe-line across the Schuylkill River at Reading. The width in this particular part of the river along the line is about 400 feet, and the deepest part about 10 feet below extreme low water; the average depth being about 8 feet. A 30-inch cast-iron pipe was used, weighing a little over 2 net tons per length of 12 feet. The channel was excavated across the bed of the river to lay the pipe in, so that the bottom of it would be about 2 feet below the ordinary river bottom. Previous soundings with a pointed steel rod had shown the bed rock to be far enough down to allow the proper depth of trench, though the rock was scraped at several points in the dredging. The line of pipe was laid by first joining the sections suspended from trestle-work across the river by means of long screw-rods, attached to each pipe so that the entire length occupied the position it was to have in the bottom of the trench. The whole thing was then lowered uniformly by a man at each screw keeping time in the turning. The methods of setting the trestle-work, suspending the sections of pipe from the screw-rods, making the joints, and lowering the pipe, were all described in detail. Three days were occupied in the erection of the trestles, and four more in getting the pipe ready for lowering, which occupied altogether about five hours. The iron screw-rods and couplings were afterwards removed by wires attached to the keys and pins which held them to the suspension bands.

COMMUNICATED ARTICLES.

ACETYLENE AS A POSSIBLE STANDARD OF LIGHT.

By H. Leicester Greville, F.I.C., F.C.S.,
Chemist to the Commercial Gas Company.

It is only natural that, with a possibility of procuring practically pure acetylene without difficulty from the reaction of calcium carbide on water, there are rumours of the possible use of the gas as a standard of light. The only practical suggestion which has as yet been made is that of burning the gas under the conditions of air supply previously demonstrated by Professor Lewes, with a perforated screen placed in front of the flame so as to afford a constant light somewhat on the principle of the Methven screen. This might possibly be a reliable standard; but details of the actual construction of the apparatus, and of the efficiency of the working, are not as yet forthcoming.

No doubt in calcium carbide—which may now almost be regarded as a practical commercial product—we have a means of easily preparing a hydrocarbon of definite composition, which might be made available as a standard of light, if consumed under proper conditions. The suggestion of consuming the gas in a specially devised flat-flame burner, provided with a screen having a definite aperture, may be useful, and possibly accurate; but this scheme is not necessarily the best system by which acetylene might be employed as a standard. It might surely be possible to invent an Argand burner with exceedingly small holes (such as is already used in the Dibdin Argand), and provided with a suitable chimney which would enable acetylene to be used in a similar way to that in which the vapour of pentane is employed in the Dibdin standard; the height of the flame being adjusted to certain limits, and the proportion of light required being regulated by a due adjustment of a cut-off screen. Whether the pure gas could be used for this purpose, or whether a certain admixture of air would have to be employed, is obviously a matter for investigation.

The principle of using a hydrocarbon flame in which the upper portion of the light is screened off, has been proved to have the advantage that sensible variations in the height of the flame can take place without affecting the illuminating value of the standard, and that no accurate check on the consumption of gaseous material consumed is necessary. This principle is obviously conducive to accuracy of manipulation, as it eliminates any possible errors of observation of gas consumption. If it were not for this fact, it might be recommended with a suitable burner for the consumption of acetylene, that a definite and accurate unit of light might be obtained by consuming the gas at a specified rate. In a recent contribution to the JOURNAL, it has been shown that acetylene, prepared by the action of water on calcium carbide, contains a small proportion of hydrogen phosphide. This is of great scientific interest, in explaining the fact that the gas obtained in this manner has an abnormal odour. But the proportion of hydrogen phosphide found was so exceedingly small, that it is an open question whether, in considering the possibility of employing acetylene as a standard of light, this minute amount of impurity need be taken into account.

In seriously regarding acetylene as capable of development under suitable conditions to an accurate standard of light, it is obvious that the gas must be obtainable in sufficiently pure condition to practically afford an even degree of illumination under stated conditions. Although there is at present an absence of evidence on this special question, it may be reasonably assumed that acetylene prepared from calcium carbide would be pure enough to meet all practical requirements. It is quite true that the commercial article does not yield the proportion of gas corresponding to theory; but the main impurity present in the raw product must be obviously calcium oxide, which on contact with water simply forms calcium hydrate, and does not evolve any gaseous products. In fact, it is somewhat surprising to learn, from published investigations, that so much hydrogen phosphide was found, as, to the best of my knowledge, calcium phosphate is an exceedingly small constituent of ordinary chalk. One almost feels inclined to suspect that the chalk employed in the manufacture of the particular sample of calcium carbide which was examined, must have had an abnormal composition with regard to the proportion of phosphates. Whatever may be the respective merits of pentane and acetylene as available materials for use as standards of light, the latter is obviously, to use a common expression, handicapped by the fact that pentane has already been accepted under specified conditions by the Standards of Light Commission. In addition to this, after a specific agreement has been arranged between opposing parties on such an important question as the adoption of a new standard of light, any suggestion of replacing pentane by acetylene would seem like starting the subject *de novo*.

An endless amount of tedious investigation would have to be made in order to establish the value of any proposed new standard in terms of the existing candle. Of course, having already fixed the value of the pentane Argand in mean candles, the value of any other standard could be ascertained by comparison on an ordinary bar photometer. But when every circumstance is taken into consideration, it is exceedingly doubtful whether it is expedient to re-open the subject of a new standard

of light simply on the ground that, since the advent of the practical employment of pentane for this purpose, another hydrocarbon has become available. In making this statement, the question of pure scientific interest is ignored. But the scientific and the practical, although intimately connected, are not necessarily identical. In the ten-candle pentane standard we have a practical unit of light, of which the value and the necessary details of manipulation have been most thoroughly investigated, and are now well understood. We also have a simplicity of working which is, in itself, not only an attraction, but a guarantee of correctness; as in scientific work—especially for practical purposes—it can generally be accepted as an axiom that freedom from complication is inevitably conducive to accuracy. This statement involves no reproach to the capacity of the scientist to obtain the highest degree of accuracy under the most difficult conditions. It is simply intended to convey the fact that in cases where a scientific operation is conducted for commercial purposes, not by the very highest class of experts, but by somewhat less pretentious and more poorly-paid workers, it is certainly desirable to eliminate as far as possible all sources of error, more especially when the fact is recognized that *extreme* scientific accuracy has often to be sacrificed to the exigencies of having to perform the maximum amount of work in the minimum amount of time.

In considering the possibility of using acetylene as a means of producing a standard of light, it should be remembered that solid calcium carbide need not necessarily be employed. Acetylene is readily liquefiable, and therefore liquid acetylene would be as practically possible as liquid pentane, with the exception that in the case of the liquefied gas a strong receptacle, capable of withstanding a considerable amount of pressure, would be requisite. This is, however, in these modern times, a mere mechanical detail easily met, and not necessarily occasioning any practical difficulty. In fact, it is a matter for serious consideration, *quoad* acetylene, whether, with a view of using the gas as a standard of light or simply as an ordinary illuminant, it would not be advisable to supply the compressed or liquefied gas in place of the raw material for its production.

ON THE ALLEGED ESCAPE OF CARBONIC OXIDE AND UNCONSUMED CARBON FROM COAL-GAS FLAMES.

By Lewis T. Wright.

In years gone by, a very popular charge brought against coal-gas lighting was the occurrence of certain oxidized sulphur compounds among its normal combustion products; but it has been left to quite recent times to discover in those products the toxic carbonic oxide, of which a very trifling amount would render the air we breathe positively dangerous, since its effects are cumulative in destroying the oxygen-absorbing capacity of the blood—a property upon which the animal economy depends. There also appears in certain quarters to be some tendency to revive an old scare of the passage of this deleterious compound through the iron of heating-stoves and their flues. This latter danger was much more felt in those countries where the iron stove with charcoal and coke as fuel is more popular than our open coal grate, and became the subject of serious inquiries, resulting in the conclusion that carbonic oxide did actually pass through cast and wrought iron, *but only when these were heated to redness*. As the gas-stoves in use do not commonly become red hot, either in their iron bodies or their flues, the danger of the contamination of the air of our apartments by these is not to be apprehended, *even if the products of combustion of the gas consumed in them did normally contain carbonic oxide*. There is also the efficient practical test of time and use, which abundantly proves that coal gas can be consumed in dwelling-rooms without giving rise to any evil effects. In spite of this general and proved immunity from the toxic effects of imperfect combustion of coal gas, we are all aware that, under certain circumstances, the atmospheric gas-flame will—if it light back, for instance, or if it be placed so as to be unable to obtain sufficient air—give products of incomplete combustion. But these circumstances are abnormal, and can be avoided; and, further, should they arise, the evil smell of the imperfectly consumed gas would give immediate warning.

The publication by M. Gréhant* of the results of some investigations showing that the products of combustion of the Auer burner contained carbonic oxide, caused some excitement among our Continental neighbours, especially as he stated that the products of combustion of lighting gas should be avoided, more particularly those emitted by the Auer burner. This was a very serious statement, coming from a chemist whose work on the detection of carbonic oxide in the blood was well known; and it could not be allowed to pass without criticism. Professors Renk and Boshard carried out elaborate investigations, and were not able to detect the presence of the deleterious impurity among the products of combustion from the Auer burner; and Dr. Bunte, in June of this year, in an otherwise valuable memoir, since it relates to other matters, such as the durability of mantles, &c., found that, with copper oxide, the indications of imperfect combustion were so slight as to be within the limits of experimental error.† The gas-burners tested by Bunte were the Welsbach, Argand, and flat-flame. M. Gréhant had, in the meanwhile, so modified his statement as to say in a later paper that the use of the Auer (Welsbach) mantle is unattended with any danger of poisoning by carbonic oxide; and this incident of the supposed danger to health attending the use of incandescent gas-burners may now be considered as closed.

In a paper read by Professor Vivian B. Lewes before the Chemical Society,* it is stated that from the tip of a flame (the class of flame is not mentioned) there escaped unburnt 0·39 per cent. of saturated hydrocarbons and 1·18 per cent. of carbonic oxide. It is an exceedingly difficult matter to collect for analysis the gases from any part of a flame or its immediate neighbourhood so as to enable one to state with certainty that they represent the gases that would be present at that particular point if the suction-tube were not there in operation. Landolt, in his classical investigation, "Ueber die chemischen Vorgänge in der Flamme des Leuchtgases," made at the suggestion of Professor Bunsen in the latter's laboratory, analyzed the gases collected at various parts of a rat-tail flame about 100 mm. in height. He placed the fine suction-tube used for the collection of the samples vertically in the axis of the flame, and found that the small amount of suction required to draw the gases through the apparatus reduced the length of the flame about 10 mm.; and he was not able to continue his investigations on the composition of the flame-gases beyond a height of 50 mm. above the bottom of the flame, on account of the obstinate obstruction formed by the free carbon. He found that a fine wire passing through the suction-tube used for clearing it of this deposit, caused an inconvenient deformation of that flame. It is probable that the gases escaping from the tip of the flame in the experiment cited by Professor Lewes were really drawn from an integral part of the flame *before the combustion was complete*, and do not represent the gases escaping from it.

The experiments made by Mr. W. Thomson, and described by him to the British Association in 1890,† on the gases escaping unconsumed from various burners, both lighting and heating, are of a very circumstantial character, and would indicate that combustion was not, in the cases under investigation, so complete as might be desired. He adopted the method of drawing them, after removal of the carbonic acid and water, over heated copper oxide, and determining the further amounts of carbonic acid and water formed by the complete oxidation of the combustion gases. This method, unless by blank experiments it be found that the atmosphere, quite apart from the gas-flames experimented upon, is free from carbon containing compounds other than carbonic acid, is somewhat uncertain, as, where there are gas-pipes and connections, it might happen that there would be some slight escape of coal gas into the atmosphere, quite independent of the flames employed; and this would be classed as coal gas escaping from the burners unconsumed. In Mr. Thomson's experiments, no attempt was made to show in what form the (in certain cases) very important quantities of unconsumed gas existed; and it would not therefore be correct to classify his trials among those that have shown carbonic oxide as an ordinary constituent of the gases leaving coal-gas flames. He merely proved that, in some of the cases studied, there were important quantities of carbon and hydrogen, not oxidized to carbonic acid and water, escaping from gas-stove burners. The following is a recapitulation of his results :—

Carbon and Hydrogen Escaping Unconsumed per 100 Parts of Carbon completely Burned.

	Carbon.		Hydrogen.
Petroleum lamp not burning at the full	—	..	—
Do. with flame turned full on	1·204	..	0·309
Argand gas-flame	—	..	0·025
Do.	0·011	..	0·254
Bray burner, consuming 4 c. ft. per hour	1·112	..	0·095
Welsbach burner	1·500	..	0·379
Marsh-Greenall's heating-stove, burning 5·62 c. ft. per hour	1·260	..	0·300
Do., burning 5·74 c. ft. per hour	3·760	..	1·180
Do., burning 7·10 c. ft. per hour	9·740	..	1·210
Thomas Fletcher's heating-stove, with eight Bunsen burners	4·330	..	2·460
Do., burning 6·81 c. ft. per hour	6·630	..	2·000
Do., with 20 Bunsen burners, with asbestos and fire-clay back, consuming 8·14 c. ft. per hour	13·890	..	1·170
Heating-stove	20·000	..	—

The amount of unconsumed carbon found in the one case of the Argand burner is too small to form the basis of a definite conclusion. It was represented by an increase of weight determined in a chloride of calcium weighing-tube of about 0·004 grain. The quantities of imperfectly consumed carbon escaping from the heating-burners used in the various stoves examined by him are far from being unimportant, even if no portion of it existed as carbonic oxide. That so much as 20 parts of carbon per 100 parts completely burned should escape from any gas-burner is almost incredible, and is quite opposed to the writer's experience. It is curious that the Argand burner, which is of a class that, under abnormal conditions—viz., when turned on too full—gives large quantities of unconsumed gas, is precisely the burner that, under normal circumstances, has been shown by those investigators, like Gréhant and Thomson, who have found important quantities of

* *Comptes Rendus*, Vol. CXIX., p. 146; JOURNAL, Vol. LXIV., p. 472.
† See JOURNAL, Vol. LXIV., p. 823; and *ante*, p. 179.

* See JOURNAL, Vol. LIX., p. 795; *Jour. Chem. Soc.*, April, 1892.
† See JOURNAL, Vol. LVI., pp. 602, 996.

unconsumed gas escaping from other burners, to be the one freest from suspicion.

The inquiry carried out in the *Lancet* laboratory, by a special Analytical and Sanitary Commission, on the products of combustion from Welsbach, Argand, and Bray burners,* gave a distinctly negative result as regards the occurrence of carbonic oxide and acetylene in the combustion products from the two former, and but a very doubtful indication of their presence in those from the Bray burner. The experiments were conducted under severe conditions, for the burners were placed in a "small chamber 3 ft. 1 in. by 3 ft. 1 in. by 2 ft. 4 in. (with no provision for any appreciable ventilation or outlet for the gases) for eight hours, during the whole of which time the air taken from above the burners was aspirated first over potash and soda-lime to remove carbonic acid and sulphur compounds, then through sulphuric acid to remove ammonia, and finally through a dilute solution of blood." Only in the case of the Bray burner was there the slightest indication of carbonic oxide. Nor could acetylene be detected in the case of the Welsbach and Argand burners; and the indication given by the silver nitrate test on the products from the Bray burner was at the best "doubtful." The result of the inquiry was thus entirely satisfactory in dispelling any fears as to the occurrence of the poisonous gases carbonic oxide and acetylene in the combustion products from such burners. The blood test applied for the former compound is positive, as it depends upon certain changes in the character of the blood as revealed by the spectroscope—changes which are only caused by carbonic oxide; and it is capable of confirmation by the after-expulsion of this gas from the blood in which it has been collected, and its examination by other reagents that would give further proof of its presence.

The writer has on two different occasions sought for, and endeavoured to find, traces of unconsumed gas escaping from the normal flames of ordinary gas-burners, both lighting and non-luminous. The atmosphere of an imperfectly ventilated apartment, where there is much gas being consumed, is unpleasant; but it does not follow that there is on that account unconsumed gas leaving the flames. On the occasion of fitting up the large show-room of gas appliances installed by the Gas Committee of the Nottingham Corporation, he tested a considerable number of cooking-burners, in order to ascertain whether, in their normal condition, there would be any traces of unconsumed gas leaving their flames; and he invariably obtained a negative result. The writer has always contended that it is necessary, wherever possible, to arrange gas-flames in such a manner that the products of combustion should discharge themselves directly into the outside air, not because such gas-flames imperfectly consume the gas, but on general considerations of comfort; and it was for this reason that he provided a system of flues whereby every gas-stove or gas-fire, &c., which was on exhibition, and which would from time to time be shown in action, was attached to a flue, wherein was always maintained a constant draught discharging itself into the outer air.

The burners were tested in the following manner: They were placed in a small room, the air of which was tested in order to ascertain that there were not present any carbon compounds (escaping coal gas) that would give the reaction sought for. A tube was placed over the flames (but so as not to touch them); and the products of combustion, mixed probably with some air, were drawn through vessels containing cotton wool, to remove dust, organic matter, &c., and then through a column of soda-lime, to remove the carbonic acid. The gases so purified were afterwards passed over copper oxide that had been prepared *in situ* by the oxidation of fine copper wire, and then through bulbs containing lime water. The results were in all cases negative; and not the slightest trace of carbonic acid formed by the oxidation of carbonic oxide or other products of unconsumed coal gas could be detected.

On another occasion, on discovering the facility with which the inner or primary flame of the atmospheric (or Bunsen) flame could be separated from the outer cone or secondary flame,† and, when so separated, the ready extinguishability of the flame, which then is represented by partially consumed gases containing as much as 11½ per cent. of carbonic oxide, it appeared to the writer that there might be danger from a too large pre-admixture of air to the Bunsen flame (approaching the mixture when the flame might strike back). Therefore his previous experiments with large Bunsen flames were repeated in this condition of maximum air supply; and again with negative results.

Coal gas has now been used in enormous quantities for a number of years, and in badly-ventilated rooms and workshops; and there have been no cases of poisoning from the unconsumed gas leaving the burners. The action of carbonic oxide on the blood is distinct, as it forms a compound with the hæmoglobin, and can even drive out the oxygen from the oxy-hæmoglobin, forming the carbon monoxide hæmoglobin compound from which the carbonic oxide cannot be afterwards displaced by oxygen. It is in the highest degree improbable that, if there were any such imperfect combustion from lighting-burners as has been suggested by the analytical results of the various observers mentioned, considering their great variety, and that many of them are sufficiently bad, the fact would have only been recently discovered; for, in the earlier years of gas lighting, there were critics quite as well informed, and quite as willing to discover defects and imperfections in the popular illuminant, as there are to-day. The weight of scientific and practical evidence is entirely against the view that carbonic oxide escapes from the flames used for lighting. It is possible to conceive a variety of circumstances in which the burners employed in heating are unable, by lighting back, or by being confined in a flue or chimney of too small capacity, to procure the quantity of air requisite for the normal combustion of the gas passing through them; but given a free air supply, the worst burner seems to have no difficulty in completing the combustion of the gas. Before accepting any evidence based on analytical methods, it will be necessary to show that these are above reproach; and in cases where the products of imperfect combustion are found in but very minute quantities, it will be more satisfactory to prove, by blank experiments, that such minute quantities would not be found if the suspected flames were absent. In any case, the writer does not believe that an instance of imperfect combustion has ever been substantiated against lighting-burners, nor even against heating-burners of good class when employed under their normal working conditions.

* See JOURNAL, Vol. LXV., p. 122; also *Lancet* for Jan. 5, 1895.

† *Proceedings Royal Society*, Vol. LXII,

The Toxicity of Acetylene.—In a recent number of the *Comptes Rendus*, an account is given of some experiments conducted by M. Gréhant in regard to the toxicity of acetylene. He tried mixtures containing 20, 40, and 79 per cent. of acetylene (the mixtures in all cases having 20·8 per cent. of oxygen as atmospheric air); and he found that it is poisonous if inhaled in large quantities, between 40 and 79 per cent. He ascertained, however, that it is much less deleterious than coal gas. Mixed with oxygen, it is highly explosive. Referring to these experiments, M. Berthelot says the toxicity of acetylene would be much greater than it is if it were mixed with carbonic oxide or hydrocyanic acid.

Hellriegel and the Sulphate of Ammonia Trade.—It is a truism to say that the world knows nothing of its greatest benefactors; and it is probable that when a short time ago the newspapers reported the death of Professor Hermann Hellriegel at Bernburg, Anhalt, very few of those connected with the sulphate of ammonia industry recognized in the announcement the name of the agricultural chemist who was mainly instrumental in establishing the growth of the sugar-beet in Germany. Professor Hellriegel devoted his life almost exclusively to the study of the phenomena of plant nutrition. His chemical researches had to do with the nature of soils; and his physiological inquiries embraced observations on the growth and development of roots, on the water required for the growth and maturing of crops, and on the minimum amounts of nitrogen, phosphoric acid, potash, and other ingredients required by plants. Supplemented by observations on crops grown in the open field, these investigations led Hellriegel to conclusions of great practical importance, notably in connection with the sugar-beet, a crop Germany grows more extensively than any other European country—its annual average area for the last twelve years having been 800,000 acres. Bernburg, where Hellriegel lived and died, is an experimental station established for the special investigation of problems bearing upon the cultivation of sugar-beet. It was here that he made his discovery as to the capacity of leguminous plants to take up and fix the free or uncombined nitrogen of the atmosphere through the agency of the micro-organisms of their root-nodules.

The London County Council and the Water Question.—The following observations on the recent action of the London County Council in regard to the water question were among the "Notes" in the issue of the *Builder* for the 1st inst.: "The way in which the London County Council deals with the water question is enough to make the public doubt if it will ever show real business capacity. Having rejected an amendment to the report of the Water Committee that the Bills of last session should be proceeded with, it last week passed an amendment in the following terms: 'That the Council, having decided not to proceed with the suspended Water Bills, and desiring that the Council should be the Water Authority for London, it be referred to the Parliamentary Committee to report without delay the lines on which they suggest the Government should be asked to legislate.' That is to say, having declined, as was quite right, to go on with these Bills, and to leave the matter in the hands of the Government, the Council gives directions to a Committee to prepare a scheme, or its outlines, which the Government is to carry out, based on the principle that the County Council is to be the Water Authority for London. The Government, which rightly should have the responsibility of settling this great question, must be left with a free hand to lay down the principles and the details of the change. It is obviously childish for the Council to suppose that the Government can accept the outlines of a Bill from them. When the Government measure is prepared, it will be reasonable to criticize it, and for the Council to lay their views before the Minister in charge of the Bill by the ordinary means of a deputation. It is improbable that the Government will accept the primary principle that the Council is to be the Water Authority. Even if it should do, it will be on its own responsibility, and not at the dictation of the Council, which has hitherto failed to effect any solution of this important matter."

TECHNICAL RECORD.

SOUTHERN DISTRICT ASSOCIATION OF GAS ENGINEERS AND MANAGERS.

The General Meeting of this Association was held last Thursday, at the Holborn Restaurant—the PRESIDENT (Mr. S. W. Durkin, of Southampton) in the chair. The attendance of members was exceptionally large.

The minutes of the meeting held at Southampton in May last having been confirmed, the members proceeded to elect

NEW OFFICE-BEARERS.

Mr. J. L. CHAPMAN (Harrow) said he had pleasure in proposing that Mr. A. F. Browne, the Engineer of the Rotherhithe station of the South Metropolitan Gas Company, be elected President for the year 1896. He had often, in days gone by, tried to induce Mr. Browne to take this office, but had not succeeded; and nothing delighted him more than that he should have now agreed to serve the Association in that capacity.

Mr. J. TYSOE (East Greenwich), in seconding, said he could speak of Mr. Browne from personal acquaintance. It was his modesty that had hitherto kept him in the background, because he was quite sure that Mr. Browne possessed fully the qualifications necessary to make a first-class President. The Committee had always exercised great care in selecting gentlemen for this position; and all would agree that, on the present occasion, they had nominated a fit and proper person for the chair.

The proposition was carried by acclamation.

Mr. BROWNE, in acknowledgment, said that, with whatever mixed feelings a man might contemplate his election to the presidential chair of the Association, there must always be two sentiments dominating him—the sense of the great honour conferred upon him, and the recognition of the fact that he possessed the good-will of his colleagues. Both these sentiments were influencing and swaying his mind at that moment. He sincerely thanked the members for the cordial way in which his appointment had been moved, seconded, and endorsed by applause. There was another side to this question, which he might be pardoned for mentioning briefly. When the Committee, in their wisdom, suggested that his name should be put forward for the office, he gave them several good reasons why he should be excused. The Committee did not refute those arguments, but pressed their proposal; and ultimately he consented, feeling that it was necessary to support the Executive loyally when called upon to do so. The Committee must then permit him to say to the members, as he had already said to them, that he did experience some feeling of unfitness for the high position to which it had been their pleasure to elect him; and when the time came for him to enter upon his official duties, he should look to the Committee, and especially to their able Hon. Secretary, for that light and leading which would enable him to discharge those duties in such a way that the interests of the Association might not suffer in the coming year from the fact that he occupied the chair.

Mr. T. MAY (Richmond) moved that Mr. J. W. Helps be re-elected Hon. Secretary. He was sure this motion needed no words from him to recommend it to the members, to all of whom Mr. Helps was so well known; and they were greatly indebted to him for his past services.

Mr. C. E. BOTLEY (Hastings) seconded the motion, which was unanimously carried.

Mr. HELPS thanked the members for this continued proof of their approval, and promised that he would try in the future, as in the past, to do his utmost to advance the interests of the Association.

Mr. D. IRVING (Bristol) moved, and Mr. C. C. CARPENTER (Vauxhall) seconded, the election of Messrs. A. E. Broadberry and C. E. Botley to serve on the Committee, in succession to Messrs J. Tysoe and W. A. Valon.

The motion having been agreed to,

On the proposition of Mr. CARPENTER, seconded by Mr. E. BAKER (Reading), Mr. W. H. H. Broadberry (Tottenham) and Mr. W. D. Child (Romford) were appointed Auditors.

NEW MEMBERS.

The following gentlemen were admitted as members of the Association: Mr. G. W. Anderson, of Caterham; Mr. T. A. Guyatt, of Ely; Mr. R. Watson, of Hertford; Mr. F. W. Torpey, of Uckfield; and Mr. J. Donaldson, of Tonbridge.

Mr. C. C. CARPENTER then read the following paper, entitled—

GAS EXHAUSTING AND CONDENSING.

As its title implies, the present paper has been written with a view to the consideration and discussion of what are ordinarily the first two stages in dealing with coal gas after it leaves the foul main of the retort-house. Though I am aware this order is not invariably adopted, yet in those cases where washing is antecedent to the exhauster, the arguments about to be adduced would apply, but still more forcibly; and therefore their consideration may for simplicity be neglected.

Condensers, washers, and purifiers were essential features of gas-making plant long before exhausters were thought about; and doubtless in the very early days of the industry their order was thus determined, and for obvious reasons. So, too, with the exhauster; its proper position appeared to be after cooling, and before the washers through which its power could be best utilized to force the gas. Since the time when this order was determined, however, very much greater attention has been bestowed upon maintaining a higher and more constant illuminating power without the use of so great a proportion of enriching material; and one of the factors in bringing this about has undoubtedly been the continual separation of the tar from the gas. Tar so treated is admittedly poorer in benzol, by which the gas is correspondingly enriched, though it would be difficult to attach a definite candle-value to the altered conditions. If this tar separation is thoroughly carried out, very little comes forward to the exhauster; and what does is so charged with naphthalene as to have a very buttery or cheese-like consistency. It is quite inefficient to provide the necessary lubrication for the working parts of the exhauster; and this has to be supplied by the addition of oil in more or less regular quantity. There is some trouble in finding a suitable oil for this purpose, as the majority do more harm than good, by throwing down pitchy matters from the tar. After many trials, I found a mixture of pure colza, tar oil, and naphtha the best for the purpose. The oil is fed in regularly by sight-feed lubricators, worked from a fixed head of water from a tank placed above the engine-room. Even then, however, the waste oil, which is very sluggish, has to be flushed out from the exhauster connections by warm liquor; and the exhausters require careful and regular cleaning at comparatively frequent intervals. Before the practice of taking off the tar came into vogue, exhausters would run for several years without opening, and with the use of very little oil.

It was found desirable this year to remove certain portions of the plant at the Bankside works of the South Metropolitan Gas Company. Its disposition was such that the foul-main from the retort-house ran through and past the engine-room to the condenser; thence back to the engine-room; and returned past the condenser to the washers. In order to continue gas-making, it was necessary to fix temporarily an exhauster; and the simplest way of doing this appeared to be to cut the foul-main at the engine-room, and interpose the exhauster, the outlet from which ran on to the condenser. This was done at the beginning of August, since when the exhauster has been at work drawing hot gas (at about 140° Fahr.), and forcing it through the condenser and following plant. Since it started, not a drop of oil has been used for lubrication; and the working parts, when the cover was removed a few days ago, were found to be perfectly free and clean, save for a coating of very thin fluid tar. That these parts worked with a minimum of friction, is also confirmed by the readings of the inlet and outlet thermometers, the latter of which has been only slightly the higher.

As far as the working of the exhauster is concerned, I think therefore that its best position is on the inlet of the condenser, instead of the outlet. But there are weightier reasons than this. I have in my mind a gas-works where the washers as well as condensers were on the inlet of the exhauster, and where sulphur purification was rendered impossible by the infiltration of air. At more than one London works, when difficulty with sulphur compounds arises, the first steps taken are to examine the plant for air-leakage between the exhausters and the retort-house. Speaking of another works where it was the custom—and a most desirable one—to stop on Sundays, one of our most eminent engineers told me that it was his duty as an assistant to put this part of the plant under pressure every Monday, so that drawn joints or other air-leaks could be at once detected. It is my own practice to do the same whenever any difficulties with illuminating power or sulphur arise.

But is it necessary to run this ever-recurring risk? Why have any part of the apparatus working at a pressure below that of the atmosphere when it works at least equally well, and all danger from air-leakage is obviated, if the exhauster is arranged to draw hot gas direct from the retort-house foul-main? It will, of course, be seen that exhausters either of larger capacity or run at a higher speed would be required. A cubic foot of gas at 70° Fahr. becomes 1¼ cubic feet at 140° Fahr. But this would be more than counterbalanced by the advantages set forth, to which may be added the increased rate at which the tar would be condensed by reason of the additional pressure to which it would be subjected.

Mention has been made earlier in the paper of the Sunday "stop," now almost universal in London. It has been urged as an objection to this that it necessitates the changing of so many valves, that it is more trouble than it is worth. This arises from a misunderstanding. A bye-pass governor fixed between the inlet and outlet of the exhauster, and weighted to give (say) ½ inch of pressure on the retort-house, is all that is required; and the inlet of the exhauster is the only valve it is necessary to close. The only valid objection to the Sunday "stop," is in the disposal of "light" gas. But all trouble on this score is entirely obviated by the use of such enrichers as the Clark-Maxim, Kemp, Price, and others.

The concluding portion of this paper may be not unfitly appropriated by a few remarks upon condensing. As with exhausting, so too with condensing, taking off the tar has resulted in a considerable modification of the part played by the apparatus. At any rate, as regards Newcastle coal, the increased production of naphthalene is unfortunately connected with modern practice in the economical production of coal gas. Pending a much-

desired investigation into the circumstances of its formation in the retort, it behoves us to take all precautions that it does not become an unmitigated nuisance to our consumers. Hydraulic-main tar will, at a temperature of 130° Fahr., dissolve upwards of 70 per cent. of naphthalene. So that it will be seen what a powerful factor in removing this is eliminated by using liquor seals in the hydraulic mains. It is in the condenser, however, that the excess of naphthalene over and above what the gas will carry at normal temperatures should be removed. Indeed, were it not for this troublesome hydrocarbon, condensing might, perhaps, be dispensed with altogether. The fundamental difference between the serpentine or worm condenser and the vertical type (whether air or water cooled), is that in the one case the condensed fluids travel throughout the entire length; while in the other, each leg or each pair of legs is separately drained, and the products run straight away out of further contact with the gas. In both cases, naphthalene will be generally found in the outlet portions, and in larger quantities in the vertical than in the serpentine type, since the solvent tar is more frequently drawn off. In order to economically dissolve this naphthalene,

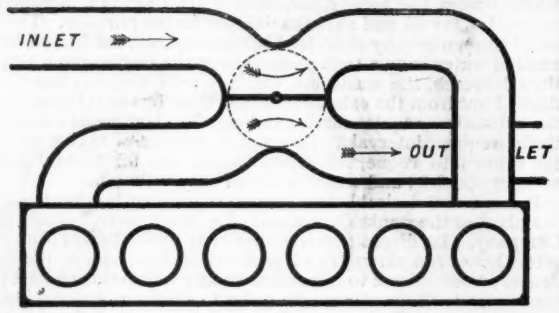


Diagram of Reversing Arrangement of Condensers at Bankside.

[The four-way valve, showing by dotted lines, on being turned one quarter round, making the diaphragm vertical, would reverse the current of gas through the condensers.]

I arranged one of the condensers at Vauxhall so as to be reversible. When the outlet became partly choked, it was made the inlet. The tarry vapours of the hot inlet gas dissolved the deposit, which was quickly run off through the seals. The arrangement has answered very well; and I had hoped to have an adaptation of it at work at Bankside sufficiently long to have laid before you some more exact data as to the quantity removed. The diagram shows the reversing arrangement, which is simply a four-way valve by which the condenser (in this case a vertical one) can be handled as described.

Before bringing to a conclusion this brief sketch, in which my object will be attained if I have laid the foundation of a good discussion, I should like to add one remark as to the practice of burying underground the various mains and pipes on a gas-

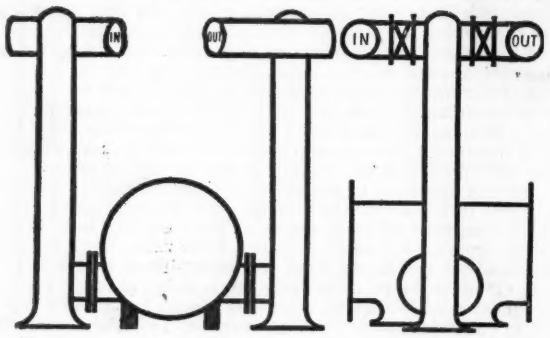


Diagram showing Overhead Mains and Exhauster Connections at Bankside.

works. Would they not be better overhead as much as possible, where they can be examined and cared for, instead of hidden out of the way? We should not treat steam-pipes in that way; why, then, gas-mains?

Discussion.

Mr. T. May (Richmond) said the paper was an interesting one; and it seemed to bear principally upon the question of naphthalene. Some time ago he found it practically necessary, in his works, to abolish the condenser; and he ran his exhausters at a somewhat similar temperature to that mentioned by Mr. Carpenter, with corresponding results. They had had no trouble from the sticking of the exhausters; and, as a matter of fact, his exhausters had not been opened for the past three or four years. As they were running all right, they left well alone. In his paper Mr. Carpenter seemed to recommend condensing as a new way of getting rid of naphthalene. This was a very important point. But he (Mr. May) could not say that they found the naphthalene trouble any greater from the fact that, to a large extent, they had done away with their condensing; and this was rather contradictory to Mr. Carpenter's experience. He supposed Mr. Carpenter had not had the arrangement in use long enough to say whether they felt any benefit in the district from its employment. That was where the trouble came, and there would be the crucial test, because they knew that the changes of temperature had so much to do with the deposition of naphthalene. During the short spell of cold weather a few weeks ago, they were bothered with it in his district; but, as soon as there was a change of temperature, the difficulty disappeared altogether. He endorsed what Mr. Carpenter had said as to a thorough investigation of this subject. If they could only induce someone to take up this naphthalene question, and settle something about it—how it was formed, and why—and introduce to gas managers some means of making gas without so much of it, they would be very pleased to support such an investigation; and no doubt gas companies would subscribe liberally towards the expense incurred in carrying it out. He would suggest to Mr. Carpenter that he would earn their gratitude by bringing about such an investigation. He might add that doing away with the condenser, in his case, had practically raised the illuminating power of the gas ¾ candle.

Mr. Helps said the paper was a very practical one; and, though short, it gave them a great amount of food for discussion. He should like to say a few words on the subject, inasmuch as last winter he made an experiment, which was partly prompted by talks he had had with Mr. Carpenter, and partly due to knowing what Mr. May was doing in this line. For some six or seven months, they entirely dispensed with the condenser at Croydon. This was not exactly what Mr. Carpenter was doing, as he simply altered the position of the condenser and exhauster—practically reversed them. Mr. Carpenter mentioned that one of the main reasons that led him to adopt this principle was the fact that he constantly had trouble with his exhauster. He (the speaker) could not say that they ever had difficulty with their exhauster. It never seemed to stick; and they never had deposits of anything solid or of a buttery consistency such as was referred to in the paper. He (Mr. Helps) used ordinary tar oil for the exhauster; and it ran very well. He must say this, as bearing out the concluding remarks of Mr. May, that they did their exhausting at 120°; and, passing the gas straight into the scrubbers, they obtained an increase in illuminating power of something like ½ to ¾ candle; and as it was only necessary to enrich to the extent of 1 candle at Croydon, it was a question whether they would not be able to do without enrichment altogether. However, they found very shortly that they were getting a serious increase of back-pressure in the scrubbers—especially the Kirkham, Hulett, and Chandler one. They tried warming the water. The difficulty then was that, instead of being able to extract the ammonia from the gas with 10 or 12 gallons of clean water, they had to go up to 20, 25, and even 30 gallons before the ammonia could be extracted. The consequence was that not only were they using a valuable commodity, water, but they were weakening the liquor to such an extent that their sulphate plant was scarcely capable of dealing with the amount of liquor produced. They had returned to the principle of putting on a condenser, and working in the usual way. He was much pleased with the latter part of Mr. Carpenter's paper, in which he suggested the reversal of the inlet and outlet of his condenser. Last year, at Croydon, they started a new retort-house and a new condenser; and they had had from time to time to throw it entirely out of use, simply because it got choked—principally at the cooler end—with pitchy tar and naphthalene. He thought he would try to get out plans for putting into practice some such idea as Mr. Carpenter had described, as it seemed to be a step in the right direction. In connection with the remark by Mr. May, that it would be a good thing if someone would take up the question of investigating this naphthalene bother, he should like to refer to a matter that had been before the gas world for some little time. They had, he thought, lost an opportunity of starting a body of some kind by whom such investigations could be carried out. There was—he might say almost there is—a small gas-works on the market that could be bought for a mere song. He hoped they would not think he was speaking personally in this matter; but, if such works could be taken up by a few men not as a commercial venture, but for scientific purposes, he was convinced that a great deal of good would result. He heartily wished someone would take this matter in hand.

Mr. D. Irving (Bristol) remarked that the difficulty Mr. Helps had mentioned with regard to the removal of the ammonia after he had done away with his condensers, was the very trouble that one might anticipate. One suggestion that he would venture to make for dealing with the difficulty of the condensers stopping up at the cool end, and one which had been adopted at the works under his care, was to carry a 2-inch pipe to the top of the condensers, and from that pipe run ¾-inch pipes into the first three or four legs of the condenser, and periodically pass a quantity of liquor through. This he found was quite efficient in keeping a set of condensers (which were previously a great trouble) perfectly clean, and in working order. The condensers were large in proportion to the work they had to do; and they previously had the difficulty Mr. Helps had explained, which necessitated, every now and then, that the condensers should be put out of action to clean them, in order to get the gas through. It was two years since the arrangement he had described was

adopted; and there had not been the slightest difficulty, although the condensers had been in continuous work.

Mr. A. F. Browne said he supposed the point was that the naphthalene must come down out of the gas. Hitherto, or until a comparatively recent period, the tar, having been allowed to flow with the gas, had absorbed the naphthalene, and carried it away to the seals; and there had been no further trouble so far as the removal of naphthalene was concerned. They were all wishful of getting rid of the tar at the earliest spot, or at the highest temperature, because it not only absorbed the naphthalene, but carried down with it the other hydrocarbon vapours they were so desirous of retaining in the gas. He believed it would be possible to assist the retention of the naphthalene vapours by enriching the gas while it was hot; but he was not prepared to say whether it would pay to do it. Undoubtedly, if they added a hydrocarbon vapour that had a high vapour tension to coal gas, it would assist in retaining those hydrocarbon vapours which existed in coal gas at a lower vapour tension. But the naphthalene, under present conditions, must come down. The point he did not quite see in Mr. Carpenter's paper was, how, in this reversible condenser, in which the temperature at the outlet was such that naphthalene was deposited in large quantities, he could have a sufficiently hot gas to dissolve the naphthalene out.

Mr. Carpenter: The gas at the inlet has the temperature of the foul main—138° to 140°.

Mr. Browne: And it is close to the retort-house?

Mr. Carpenter: Yes.

Mr. Browne: And you find at the outlet of the condenser that a large proportion of the naphthalene is deposited?

Mr. Carpenter: Yes.

Mr. Browne: We are not troubled with naphthalene until the gas has passed through, roughly speaking, 200 yards of condensing-main.

Mr. Carpenter: That would form the outlet of your condenser—after the gas had passed through that 200 yards of condensing-main.

Mr. Browne: I have no current of hot gas to reverse with.

Mr. Carpenter: You would have a current of hot gas when you reversed it.

Mr. Browne: How is your gas hot enough to enable you to reverse the current with effect? That is my point.

Mr. W. E. Price (Hampton) asked what was the average temperature at the outlet of the condenser. He found he did not get any trouble at the outlet, providing he maintained the temperature sufficiently high. This was with a sort of working half-way between the suggestion of no condenser and the ordinary method of using a condenser—all of it—without taking any notice of what the temperature might be. By carefully watching the temperatures, and keeping them at from 60° to 75° Fahr.—which meant more often in the winter time not using a condenser at all—he had no trouble in the way of blocking. There was one difficulty he should like to mention; and he should be pleased to know if Mr. Helps's experience was the same—whether, when not using his condenser, he found that, in passing the hot gas on towards the scrubbing and washing plant, his stock of ammoniacal liquor was raised to a temperature whereby he lost ammonia. When he (Mr. Price) was not using his condensers, he found that his ammoniacal liquor was increased to such a temperature that they could notice all about the works that ammonia was being given off by the liquor.

Mr. Botley said it had been remarked that it would be a good thing if someone would undertake an investigation with regard to the naphthalene question. At Hastings, they had been forced to make an investigation for themselves through the trouble it caused. It was a great many years since he had been engaged in finding a preventative for naphthalene on the works; and so far the result had been that the prevention of naphthalene on the works had been accomplished. But they still had the difficulty of naphthalene in the district. Naphthalene on the works could be prevented by keeping a liquor seal, instead of tar; by drawing the tar off quickly; and by condensing-mains. They had none in the works or in the condensers now. They used to have; but now they had it in the district, in spite of every precaution. They had a spell of cold weather in October—there was a sudden fall in the temperature; and they had over 1000 cases in one week to deal with. The result of his investigation had been this: That the trouble on the works was nothing compared with what it was out-of-doors, with complaints from consumers, and threats to adopt another source of light. He was going to treat the gas as it left the works, with the view of eliminating the naphthalene. His experiments had been in progress for a good time now; and from the results obtained in the preliminary experiments, he hoped to be able to accomplish the desired end. He might also mention that they were putting up carburetted water gas plant at Hastings; and it was his intention to introduce the carburetted water gas into the foul main. They would have the means of taking it direct away; but he intended to try the experiment of placing it in the foul main with the coal gas, because he was inclined to believe that there was a gain in illuminating power in this way. If some of the tar was taken up by the vapours of the water gas, they would get an increased enrichment. If anything could be done in this way he should be very glad. He might also state that his was a water condenser—not a vertical one. It was erected about eight years ago; and he never had any trouble whatever with it. In his experience with exhausters, he had had the same difficulty of getting an oil that was constant. But recently they had had a great deal of trouble, and had had to abandon the use of tar oil, and to use a lubricant something similar to that Mr. Carpenter had suggested. He certainly agreed with the author that the mains should not be hidden. At his works, if he could not put them overhead, he laid them in channels underground, so that they could be readily examined.

Mr. C. Gandon (Lower Sydenham) said the naphthalene difficulty was, he supposed, one that bothered and interested them all. He agreed with Mr. Botley that, as a rule, the difficulty was not so much on the works as in the district; and, therefore, he did not know that any different arrangement in the condensing plant would get over that part of it. He should be pleased if some member could suggest how they could get rid of the trouble in the district. As to putting the exhauster before the condenser, that was a very old idea. He could remember that even Mr. Beale, in his time, recommended placing the exhauster before the condenser. He recollected that, in the works he (Mr. Gandon) was then connected with, it was in that position; and it gave them a great deal of trouble. It was constantly getting choked up with sticky tar. At the same time, he thought that probably in many cases, they carried condensation to too great an extent. He endeavoured with their condensers to maintain the gas at somewhere about the normal temperature of the atmosphere; and he thought that was about the best thing one could do. If they kept the temperature too high, it interfered with the action of the purifiers; and if it was too cold, it did the same. He experienced no particular difficulty with deposits of naphthalene in or about the condensers or the purifiers. Where they did get deposits of naphthalene occasionally was in the inlets or outlets of the gasholders; but he did not know that the position of the exhauster would have anything to do with that. He should be very pleased if someone could point out the way in which they could deal with the terrible nuisance of naphthalene stoppages in consumers' pipes and services. It had been talked about a good many times; but he did not know that anything effectual had been proposed for it yet. A circular reached him a day or two previously from some people who said they had a perfect cure for this trouble, and that it had been used with the utmost success by the Crystal Palace District Gas Company. (Laughter.) All he could say was he had a keg of the stuff in the laboratory; but they had never used it. They tested it, and found it was chloride of calcium. However, he intended to try it.

Mr. Robert Morton (London) said he rose for the purpose of making two suggestions. The first was that Mr. Botley (who was proposing to treat his gas, before he sent it out, for the elimination of naphthalene) should rather try to treat it so that he carried the naphthalene forward to the burners.

Mr. Botley: I intended to say retain the naphthalene in the gas or prevent its deposition.

Mr. Morton thought that Mr. Botley had made a mistake. In an investigation as to the cause of the deposition of naphthalene by a very eminent chemist, it was found that, if the gas was properly dried or desiccated, naphthalene would not become deposited. There must be moisture in the gas before the naphthalene could be deposited. There was the drawback that, to properly dry the gas, and so cause the naphthalene to go forward to the burners, they would require in big works very large apparatus. The other suggestion he had to make was that, if anyone had difficulty with his exhauster, or wished to carry more of the illuminating constituents of the gas forward to the gasholder, he should try the system which Mr. Carpenter had adopted at the Bankside Gas-Works of putting the exhauster on the hydraulic main; and he would advise anyone doing this to adopt a bye-pass arrangement. At one large works of which he (Mr. Morton) had charge some years ago, they had a make of from 4 to 5 million cubic feet per day; and the exhauster there was on the hydraulic main; and the condenser was a large vertical one, in two sections. They were so troubled with naphthalene that they were obliged to work only one-half of the condenser, and shut the other half off in order to clean it; and as soon as the latter was ready, it was time to turn the gas into it, and clean the other half. Condensing under pressure would throw down naphthalene; and Mr. Carpenter's arrangement of turning the hot gas into the outlet of the condenser was absolutely necessary if the work was to be carried on with anything like comfort.

The President observed that, like many others who used Newcastle coal, he certainly knew something about naphthalene. In regard to condensation, they had at Southampton foul mains in all the retort-houses; and during the recent "snap" of cold weather, they entirely condensed their gas in the retort-house, and completely shut off the outdoor horizontal plant. Their exhausters were all on the outlets of the condensers. The primary tar was taken off at the bottom of the hydraulic mains; and this system had been working for some years, and had been improved upon gradually. Notwithstanding the foul mains in the retort-houses, they still had their horizontal condensers out-of-doors choked with tarry naphthalene; and as he did not possess a reversing-valve to work the inlet and outlet, the condensers were sectionized. Thus he was able to use one or two or half a condenser, or shut one off altogether. They removed the plates

at the ends of the pipes, and, putting a disc in, they drew the stuff out by means of a chain or sometimes a crab; and then it would work again for a long time. They found the deposition was at the cool ends of the pipes, where it became thick. They had occasionally to attend to the inlets and outlets of the gas-holders, and clean them out by plunging or some other simple means. In certain districts, they were much more troubled with naphthalene outside the works than they were in others. His experience was on all-fours with that of previous speakers. During the recent cold weather, they had a great number of complaints not only of service-pipes being choked, but mains in different portions of the district; and in some parts, they knew pretty well where to go and look for stoppages at certain times of the year. But this season, he had had stoppages in mains where he never expected to find them. He was speaking to a professional colleague not long since, and asked him whether he found any naphthalene out-doors; and he replied "hardly any." He did not, however, know the reason, unless it was that his mains were laid almost entirely in chalk soil. In his (the President's) own district, the soil was gravel, clay, and at places sandy stuff; and according to the nature of the soil did he find the deposition of naphthalene. He supposed that pipes laid in chalky soil were much drier; and therefore any moisture there was in the gas would not have so much influence in causing the deposition of naphthalene.

Mr. CARPENTER, in replying upon the discussion, said he should much rather have preferred reading a paper on how to prevent the formation of naphthalene in the retorts. But he was unable to do that; and the one they had been discussing was the next best thing he could manage. It was very evident that gas at the temperature of the hydraulic main must contain considerably more naphthalene (which was extremely volatile at ordinary temperatures) than it could carry at normal temperatures; and, as soon as the temperature fell, it was certain the naphthalene must come down somewhere. As long as they carbonized coal in the way they now did, naphthalene would be produced in the retorts. Whether it was possible to control the temperature at the latter part of the distillation, at which the greater part of the naphthalene was formed, he was not sure; but if anything was done, he believed it would be in this direction—that they would prevent the formation of naphthalene at the latter part of the charge. There was another point touched on by Mr. May. That was the question of naphthalene in the district. Well, he (Mr. Carpenter) would say they had better have naphthalene in the works than in the district. If they had it on the works, they only upset themselves. By maintaining the temperatures, they would have no deposition on the works; but they would have it in the district. Mr. Helps had related his experience of shutting off a condenser. There was a gain in the illuminating power of the gas; but the scrubbers became blocked up. This blocking up was due to the cause he had mentioned—that was, the temperature being reduced, the gas had more naphthalene than it could conveniently carry; and it was deposited in the scrubber instead of the condenser. It seemed to him (Mr. Carpenter) that the best place to part with it was in the condenser, because they could take it out better from there than from the scrubber. Mr. Irving had spoken of the loss of ammonia. That, of course, was a difficulty so long as pure water was used for taking up the final trace of ammonia. In those works where sulphate was made, there was a system of using diluted sulphuric acid to take up the last trace. Mr. Irving stated that he flushed out the condensers with liquor; and he (Mr. Carpenter) had to do the same thing. But his objection to flushing out condensers with liquor was this, that the liquor made streams in the naphthalene through which the gas passed, instead of getting the benefit of the whole area of the pipe. At any rate, that was his (the speaker's) experience. As to Mr. Browne's remarks about enriching hot gas, Mr. Foulis, of Glasgow, had found precisely the advantage in enriching with water gas—quite apart from the making of carburetted water gas—that Mr. Browne had suggested. Mr. Price had spoken of the temperature at the outlet of the condenser. If it was kept high, they would not have trouble with naphthalene; but if it was kept down to something like normal temperature—say, 60°, or perhaps below—they would get it. But they had better have it in the condenser than in the service-pipes. Mr. Botley had referred to the prevention of naphthalene on the works. He (Mr. Carpenter) should like to ask him how he had prevented it.

Mr. BOTLEY: By drawing off the tar; and by arranging the condenser as you have described.

Mr. CARPENTER: You have just as much in the district as ever?

Mr. BOTLEY: Yes.

Mr. CARPENTER (proceeding) said there was one other point which had not been touched upon, although he endeavoured to lay some stress on it in the paper—that was the question of drawing in air when they did not want it. He was visiting a large works some time ago where they found it absolutely impossible to purify from sulphur compounds, because they drew in so much air, simply through leaks in their washers and condensers. They drew in so much that all the sulphuretted hydrogen got burnt up in the first instance. This was the reason why plant of any kind under vacuum should be done away with. If air was wanted, let it be drawn in where, and in the quantity, required; but they ought not to do it in the indiscriminate manner which would often be the case with plant under vacuum. Mr. Gandon had spoken of the difficulty with naphthalene in the district. There, too, it seemed to him (Mr. Carpenter) it was a question of temperature as much as anything else; and if steps were taken to reduce the temperature at the works, he would get the naphthalene deposited there. But his paper was not exactly one upon naphthalene; it was on "Gas Exhausting and Condensing." As had happened in so many cases, however, it seemed to him they had gone off at a tangent. He was pleased to hear the remark Mr. Botley made in reference to burying mains. It would be a good thing if more of the mains were put where they could be seen, instead of burying them underground, where no one knew what happened to them.

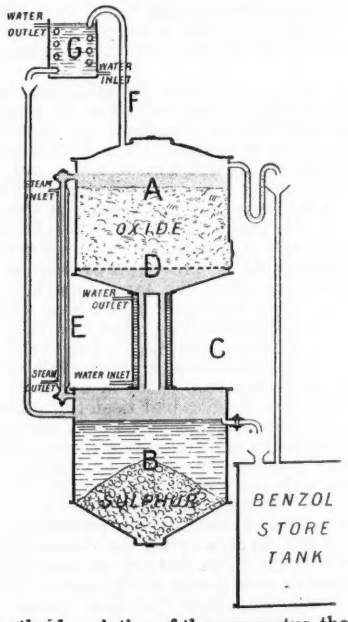
Mr. R. P. THOMAS (Ware) asked to be allowed to add a little of his experience to the discussion. He was in charge of a small works, where, in his time, they had increased the consumption of gas from 5 millions to nearly 13 millions. He had had difficulty with naphthalene, principally in cold weather. He had 400 consumers; but during the last severe weather, he received only two complaints. He had 130 public lamps; and some of these had been stopped time after time. The remedy he had adopted was naphtha. He had had a tee introduced, with a simple ½-inch plug, in the rising pipe. Now when the difficulty arose, he had only to take out the plug, and pour in a ¼-pint of naphtha; and by the time they wished to light up, they found the lamp clear.

Mr. A. E. BROADBERRY (Tottenham) read the next paper upon

CLEANSING SPENT OXIDE.

It is with a considerable amount of diffidence that the author places before the Association the results of some small-scale experiments made at Tottenham, with a model apparatus which, though designed for use in another branch of commerce, is believed to be applicable to gas-works for the extraction of sulphur from spent oxide, leaving the material in good condition for re-use. The diffidence is real; and it arises from the slight practical value generally and properly attaching to experiments of this class. Indeed, this paper would not have appeared at all, had it not been understood that there would be no other paper forthcoming for this meeting. It had been hoped that the results of working with an apparatus dealing with a ton at a time would have been available; and on the strength of this, a promise of a paper had been made. But, unfortunately, the machine was not ready in time; so that it became a question of either breaking the promise made to our esteemed Secretary, or compelling you gentlemen to listen to an essay on possibilities instead of a record of accomplished facts. The former alternative could not be entertained.

The subject, however, is one of sufficient importance to the industry with which this Association is identified, to render it desirable that the opportunity should not be lost of making the members acquainted with the system; and it will perhaps be something in extenuation that the apparatus used (which was kindly lent by the inventors) is on a somewhat larger scale than is generally employed in the laboratory. As the oxide was in no way prepared, but was treated in its normal condition, it may be relied on that the results could be reproduced on any larger scale.



To facilitate the description of the apparatus, the accompanying sectional drawing has been prepared, showing its arrangement. Its simplicity is at once apparent. The upper, or oxide, vessel A is connected to the lower, or sulphur, vessel B by the water-jacketed pipe C, with the filter or strainer D above it to prevent particles of oxide from passing down. A further connection between the two vessels is made by the steam-jacketed

pipe E. The ventilating-pipe F is attached to a water-cooled condenser G; the condensation being returned to the apparatus. It will be noticed that, except for the stopcocks for steam, water, &c., and the doors for charging and discharging, there is an entire absence of cocks, valves, or working parts to be manipulated—in fact, the process of working is as simple as the apparatus itself.

The oxide to be treated is placed in the upper chamber—the lower one being about half filled with water; and then benzol, or other similar solvent, is put in up to about the overflow, entirely covering the oxide. To set the apparatus in operation, all that has to be done is to pass a small current of steam into the steam-jacket, and a flow of cold water through the water-jacket and through the condenser. The heat communicated to the solvent in the pipe E, induces an upward flow, and discharges it on to the top of the oxide in a heated condition—that is to say, at about 70° to 80° C. The return flow of the solvent is through the cooling-pipe C, which has its central portion occupied by a cylinder, the better to expose the solvent to the cooling surface; and this deprives it of its heat, returning it to the lower chamber at about (say) 25° C. The circulation thus produced continues automatically, so long as the steam and cold water are supplied to their respective places.

Benzol at its temperature of 70° to 80° C. in the upper chamber, will dissolve 2½ to 2¾ lbs. of sulphur per gallon; but when cooled to 25° C on its return to the lower one, it will only retain ¼ lb. per gallon. It therefore follows that for every gallon circulating, while there is plenty of sulphur in the oxide on which it can act, over 2 lbs. of sulphur are extracted from the oxide and deposited in the water at the bottom of the sulphur vessel. It will be seen that the principle of action is the different absorption of sulphur by the solvent at varying temperatures. Having filled the apparatus with spent oxide, water, and solvent, and turned on the steam and water, the apparatus may be left to itself until the extraction has ceased, when the benzol is drawn off and the oxide thoroughly steamed, to distil and recover the benzol with which it is saturated.

For the following calculations, the quantity of oxide treated was 20 lbs., and its percentage analysis before cleansing was—

Water	11·2
Sulphur	54·0
Purifying material	34·8

Or, calculated on the dry basis—

Sulphur	60·8
Purifying material	39·2

The total weight of sulphur in the 20 lbs. operated on is therefore calculated to have been 10·8 lbs., of which over 10 lbs. were extracted by the process.

The following is a test of the oxide after treatment:—

Water	40·8
Sulphur	5·6
Purifying material	53·6

Or, calculated on the dry basis—

Sulphur	9·5
Purifying materials	90·5

The water used in the water-jacket and condenser was run into a tank, and accurately measured. To ascertain the quantity of steam used, a condenser was placed on the steam-outlet; and the condensation gave the amount of steam employed. The time occupied was 7½ hours, during which, except for noting the statistics necessary for this paper, no attention was required. The solvent used was benzol, carefully measured before and after the experiment; the loss being just 1 per cent.

Having described the apparatus and the method of working, it has now to be seen what commercial figures can be deduced therefrom. The value of one ton of spent oxide, 54 per cent. sulphur, at 2d. per ton per unit, would be 9s., less 6d. for loading, or 8s. 6d. net. The cost and revenue of applying this method to one ton is estimated in the following statement. The figures based on the working of the small machine are believed to be excessive on the Dr. side for one of larger dimensions.

Dr.				*Cr.*			
Spent oxide, 1 ton	£0	8	6	Cwt. qrs. lbs. 10 0 16 sulphur at £2 15s.	£1	7	11
Water, 2016 gallons	0	1	6				
Steam, 303 gallons water evaporated at 1d. per 10	0	2	6	13 3 19 50 p. ct. purifying material at 30s.	1	0	10
Benzol, 1 p. ct. on 400 gals.	0	4	0				
Labour (estimated)	0	6	0				
Profit	1	6	3				
Total	£2	8	9	Total	£2	8	9

The advantage to be gained may therefore be taken to be 26s. 3d. per ton of spent oxide.

It may possibly be urged that, with the limited quantity of oxide in use in most gas-works, the extra trouble makes "the game not worth the candle." In these days of sliding-scales, however, with the attendant desire to reduce the price and incidentally increase the dividend, not only must every item of expenditure be watched, but the merest possibility of improved working, however small, must receive its fair share of attention, if it will appreciably affect the cost per 1000 cubic feet. If then the calculation be made in this direction, it will be found that, estimating that one ton of oxide is used for every 2 million cubic feet of gas made, giving 28 cwt. of spent material, the saving would represent 0·22d. per 1000 cubic feet.

Attempts have previously been made for commercially extracting sulphur from spent oxide; the carbon bisulphide process being perhaps scientifically the most perfect. At the same time, practically it is highly dangerous; and probably no gas engineer would admit it on his works. The existence of carbon bisulphide in the gas is not sufficiently welcome to him to lead him to seek a further acquaintance. But with benzol and similar oils, he is already well acquainted in the enrichment of gas; and even should the vapours escape, they have a familiar odour, and do not cause that distress to the human system which carbon bisulphide does. On the other hand, should any be left in the oxide after the cleansing, it would merely tend to improve the candle powerof the gas. [Samples of the cleansed oxide, and also of the extracted sulphur, were placed on the table for inspection by the members.]

In concluding this paper, a few words of protest will not be out of place against a custom ruling in the oxide market. It is well known that quotations usually contain a clause providing that any percentage of water in excess of 50 per cent. will be deducted from the invoice—meaning, apparently, that one-half of the weight charged for is to be purifying material, or an allowance will be made accordingly. Let it be assumed, then, that a delivery comes in containing 60 per cent. of water. An allowance would be made of 10 per cent., which, at first glance, appears fair and satisfactory. But it is the solid matter, not the water, that it is desired to buy; and 60 per cent. water means 40 per cent. instead of 50 per cent. of oxide—four-fifths, or 80 per cent. The reduction should consequently be at the rate of 20 per cent.

It is obviously to the advantage of the sellers to make the moisture as high as possible; and it is rarely found that they fail to do so. When a reduction is claimed, and they allow it, they pocket an equal amount themselves; or, in other words, allow only one-half of what they should. Besides this, there are doubtless many cases in which the moisture is not tested, and no claim made; and then the sellers have all, instead of half, of what should belong entirely to the buyer.

Taking the extreme case shows the folly of it, so let us assume that 100 tons of oxide are ordered, and the seller pumps 100 tons of water, pure and simple, into a barge and delivers it. The invoice would be made out as follows:—

To oxide of iron . . . . . 100 tons.
Less excess of water 50 per cent. 50 ,,

50 tons at 30s., £75.

That is, £75 for 100 tons of water, and not a particle of oxide. It seems stupid; but it plainly illustrates the fact. One would naturally complain under such circumstances; but all the satisfaction one would get would be the reply: "We admit your point; but it is the custom of the trade, so we regret we can do nothing in the matter."

At Tottenham, for some years, attempts have been made, with varying success, to break the custom. Combined action by all the members of this Association would no doubt put an end to the iniquity.

Discussion.

Mr. C. C. CARPENTER said the subject dealt with in the paper was one in which they were all interested; and, for himself, he cordially agreed with what Mr. Broadberry had said—that, in these days of cheap gas (that was what he meant when he spoke of the sliding-scale), they could not afford to neglect anything that would enable them to work more economically. With reference to this method of recovering sulphur from the spent oxide, it seemed to him that it was a novel one; and he could not conceive an apparatus better calculated to carry out the object Mr. Broadberry had in view. As he truly said, the method of using carbon bisulphide had long been known; but he gave a cogent reason why they should not have more carbon bisulphide on the works than they themselves produced. He (Mr. Carpenter) could not conceive a better material than the one suggested in the paper for recovering the sulphur; but at the present stage, it would be a little bit difficult to attach a definite commercial value to these operations. He noticed Mr. Broadberry said that, estimating that one ton of oxide was used for every 2 million cubic feet of gas made, giving 28 cwt. of spent oxide, the saving would represent 0·22d. per 1000 cubic feet. To use a ton of oxide for 2 million cubic feet of gas was rather large. He did not know whether Mr. Broadberry was estimating that the purification was done by oxide of iron only. He (Mr. Carpenter) thought that he must be, because otherwise he would not require a ton of oxide to purify 2 million cubic feet of gas. With reference to the last portion of the paper, the difficulty with the amount of water in his (what he supposed was) bog oxide was one they had all experienced. There was a simple way out of that, which was to use, not bog oxide, but pure oxide of iron. They could purchase this for 28s. or 30s. per ton; and they could put with it as much bog as they liked to suit their particular tastes and the pressure it was desired to work with in the boxes. They had used this material very largely in the South Metropolitan Gas-Works; and certainly he very much preferred it to bog oxide. He thought one reason was that the stuff was in an extreme state of fine division; and it had not the disadvantage that bog oxide had of being mixed with clay. It seemed to him they could get far more nearly the theoretical value out of this oxide than they could out of the bog oxide.

That was his experience. They could work it in their catch vessels; and the layers of these came out perfectly hard and caked. Then, when the material got fairly charged with sulphur, instead of rejecting the whole parcel, they could add (say) 5 or 10 per cent. of powdered oxide of iron again; and the material was as fresh as ever. This was a very important advantage in the use of finely powdered oxide of iron.

Mr. BOTLEY said that to those who used oxide, and were far removed from any place of disposing of it, the system described would undoubtedly be an advantage if it was practicable. Fortunately there were other things to be considered in spent oxide besides sulphur. There were the cyanides. At Hastings, they had lately been able to dispose of a large parcel of spent oxide on account of the cyanides it contained; and they obtained for it double the price that Mr. Broadberry estimated the value of the sulphur at.

Mr. GANDON remarked that Mr. Carpenter had referred to pure oxide of iron.

Mr. CARPENTER: I should have said precipitated oxide of iron.

Mr. GANDON said that Mr. Carpenter put the price at about 30s. per ton. He thought perhaps he was going to speak of Weldon mud or manganese. He should be glad to know where Mr. Carpenter obtained pure oxide at the price named; and how much moisture it contained.

Mr. NORTON H. HUMPHRYS (Salisbury) said he had just bought a consignment of natural oxide of iron from Gloucestershire. It contained 90 per cent. of pure oxide, 2 or 3 per cent. of water, and the rest earthy matter. It ran considerably over 90 per cent. of pure oxide—90 to 95 per cent.

Mr. MAY inquired if this invention was a patented one, and would there be any royalty to pay? In the estimate in the paper, there was nothing for royalty, or interest on the outlay, for the apparatus.

Mr. BROADBERRY, replying on the discussion, remarked that Mr. Carpenter had spoken of the figures deduced from the experimental apparatus as being of little value. That he admitted in the paper; and, as he had said, it was simply for the sake of placing the system before the members that he had prepared the paper. He also mentioned that he had been disappointed in not having had the results of experience of the working of the full-sized apparatus to include in the paper. As to the quantity of oxide used—a ton for 2 million cubic feet of gas—that, of course, referred to gas-works using oxide entirely for purification. Mr. Botley mentioned the cyanides as increasing the selling value of the spent oxide. Of course, everybody knew that oxide of iron contained a large proportion of cyanides, which increased the value of the spent oxide. The apparatus was patented; but he was unable to give any figures as to the price or royalties. He had no doubt the royalties would be included in the price of the apparatus. The inventors were now working out a scheme for extracting the cyanides from the spent oxide. At the same time, he believed it would leave a small portion of lime in it; but he was not acquainted with the system yet. Regarding the last portion of the paper, as to the custom of allowing only practically half the cost of the moisture that was generally in the oxide, he would add that no doubt this constituted a portion of the "living profit" of the sellers. He admitted they were entitled to a fair profit; but he did not think this was a just way of making it. It would be better to increase the price, and so obtain a fair profit. There was a slight connection between this point and the paper, as credit for the renewed oxide might then be taken at a higher figure.

Mr. CHILD moved, and Mr. PRICE seconded, a hearty vote of thanks to Messrs. Carpenter and Broadberry for the papers they had contributed.

The motion was passed, and suitably acknowledged.

THE PROPOSED AMALGAMATION OF THE SOUTHERN AND SOUTH-WEST ASSOCIATIONS.

The PRESIDENT said the next business was to consider a letter received from the Hon. Secretary of the South-West District Association of Gas Managers (Mr. Norton H. Humphrys), respecting a proposal for amalgamation with their Association. He did not think he could say much upon this matter himself. There might, however, be both advantages and disadvantages in the amalgamation.

The HON. SECRETARY said that some few months ago, he received a letter from Mr. Humphrys, enclosing a circular which he was sending out to the members of the South-West Association, calling a meeting to be held in September, and announcing that Mr. J. Lowe would propose that a Committee should be appointed to meet a Committee of the Southern Association to arrange terms of amalgamation. After the meeting of the South-West Association, Mr. Humphrys forwarded to him the resolution which was then passed. It was: "That this Association approves of the proposal for amalgamation with the Southern Association, and that the President, Mr. Irving, and the Hon. Secretary be appointed to meet a Committee of the Southern Association to confer on the matter, and, if desirable, arrange terms." He (Mr. Helps) brought the letters before their own Committee; and after the question had been carefully discussed, it was proposed by Mr. Carpenter, and seconded by Mr. May—"That the matter be laid before the members at the next meeting in November, with the recommendation that, if they thought it advisable, a Committee should be appointed to meet the South-West District Association to discuss the proposed scheme, and to report at the following general meeting." This was the recommendation of the Committee; and it was for the members to consider it, and to come to some conclusion as to whether or not it would be advisable to do anything in the matter. A good deal might be said on both sides. There was the question of papers; but if there was a difficulty in this respect in the two Associations, in his opinion that difficulty would not be decreased by amalgamation. Again, the South-West Association covered a great deal of ground; and the members of it were widely scattered. The Southern Association, however, could not entertain the idea of altering their rules as to the holding of their business meetings in London. Most of their members were situated in or round about London; and they always had a fair attendance at the meetings. Certainly, there were other little matters which would have to be smoothed over. For instance, the Southern Association only admitted gas managers and gas engineers, or men who were both managers and secretaries. On the other hand, the South-West Association admitted secretaries pure and simple.

Mr. F. G. DEXTER (Winchester), the Ex-President of the South-West Association, said that that body had been placed in much the same difficulty as he knew, as a member, the Southern Association had been, in securing a thoroughly representative attendance and suitable papers on all occasions. Mr. Helps had expressed the opinion that, if the two Associations were amalgamated, it would not reduce the difficulty of providing suitable papers. He (the speaker) thought that Mr. Helps was mistaken, because there would be twice the number of members available to produce papers, and consequently half the difficulty. Looking through the lists of members, it would be found that the most active men in the South-West Association were already members of the Southern Association. Regarding the places of meeting, the Southern Association might perhaps consider it a hardship to be called upon to go from their particular district to works, for instance, in the neighbourhood of Winchester, or (say) farther afield than that in the south-west district; but quite recently they had taken themselves right away to Southampton, which was strictly south-west ground. Therefore, he did not know that they ought to advance that objection, having taken advantage of the ground of the other Association so recently. Works farther west than that—say, Exeter—would not be a much greater journey for members to take from London. The members of The Gas Institute went greater distances even than that; and so what might appear to be a difficulty now, would not really be so if regarded in the right spirit. He also spoke of the expense incurred in being a member of the two Associations, and pointed out that, under the present conditions of things, there were reasons for which he wished to be associated with the Southern Association, and others for which he desired to be a member of the South-West Association. He was not so well acquainted with the working of the Southern Association as he was with that of the South-West body; but he believed it had leaked out that, on more than one occasion, there had been a difficulty in arranging a suitable place for the meetings of this Association. It therefore stood to reason that, if the two Associations were amalgamated, there would only be half the number of meetings to arrange for; and consequently less difficulty.

The PRESIDENT pointed out that the two business meetings of the Southern Association were always held in London; and the holiday meetings wherever they might select.

Mr. CHAPMAN said he had been connected with the Southern Association from the beginning; and he was the original Secretary. He felt that this question was a difficult one, and that it required a good deal of consideration before taking any definite step. There was one point which did not seem to strike some of the members, and that was that it was questionable whether, if an Association of this sort was made too large, it would be of so much benefit to members as two smaller Associations. If they made themselves into a kind of Gas Institute or Institution of Gas Engineers, would they not, he asked, be doing away with a great deal of the profit that they gained from the smaller meetings? He agreed with Mr. Dexter that it was an important point to get sufficient papers for the meetings; but it must be remembered that the Southern Association obtained a great deal of strength from the London contingent that belonged to them, in the way of papers. He was quite sure this Association must never drop one rule which was adopted when they started, and which had been the cause of their prosperity. Holding their business meetings in London would, he thought, be a difficulty for the members of the South-West Association; and it would cut off the connection of a great many of the members of that body from any Association. He felt that it was a *sine quâ non* that the business meetings of the Southern Association should continue to be held in London; and therefore a great many of the men who had been in the habit of attending the south-western meetings would be excluded from taking part in all such gatherings. Regarding the point as to expense, it would, he said, be impossible for many of them to come to London on that account. Then it was a question whether the Hon. Secretary could carry on the work of a larger body, and whether it would not be necessary to have a paid Secretary. Mr. Dexter had alluded to their meeting at Southampton. But that was the town in which their President lived; and they

generally visited the President for the year on the occasion of their holiday meeting.

Mr. IRVING (who is a member of both Associations) mentioned, as supplementing the remarks made by Mr. Dexter, that, in the south-west, they had found some difficulty in continuing the Association. He had not the least hesitation in making that confession, after the remarks they had heard as to the difficulties of carrying on the Southern Association.

The HON. SECRETARY (intervening) said that was rather a wrong impression. There had been no difficulty—at all events since he had been Secretary; and, as to papers, this year had been the first in which he had had anything that could be called a difficulty in that respect.

Mr. IRVING (continuing) said that as to papers, which were the real life of the Associations, he candidly admitted that they had had great trouble in the South-West Association; and it was such that it was incumbent upon those who had the best interests of the Association at heart to consider what should be done. He thought it would be well to appoint a Committee to discuss the question. The members of the South-West Association did not, so far as he knew, ask, or expect, anything unreasonable; and the members of the Southern Association, he was sure, would be courteous and reasonable with their arrangements. By conferring together, they could go into details more than they could hope to do that day; and they might then be able to arrive at an agreement which would be acceptable to both Associations.

Mr. PRICE observed that Mr. Helps had made a remark as to some of the South-West members not being eligible for the Southern Association.

Mr. IRVING said he did not think Mr. Helps had made any reference to members not being eligible, but he mentioned a difference in the rules. He did not think there was any particular member who was not fully qualified for the Southern Association.

Mr. PRICE (proceeding) said the point he had in his mind was the rule of the South-West Association that gentlemen who were only secretaries were eligible for membership; but they would not be so for the Southern Association. Of course, if there was one member who was a secretary pure and simple, that would be a serious difficulty in accepting the South-West Association *en bloc*; and therefore, in his opinion, it would be better to accept them singly.

Mr. W. H. H. BROADBERRY (Tottenham), as one of the original members of the Southern Association, said it had been very successful up to the present; and he did not see what they were to gain by an amalgamation with the South-West Association. But if it was the wish of the majority of the members, he would not oppose it. If there were secretaries in the South-West Association, he did not see that there would be much difficulty in accepting those who were at present members, with the understanding that they took no others. He did not think they should make any hard and fast line on that point. He suggested that perhaps it would be better for any members of the South-West Association who wished to join the Southern Association to do so, and allow their own Association to die a natural death. He would propose that the matter be left to a Committee to investigate, and report at the next meeting.

Mr. BOTLEY, who stated that he believed he was the first member to join the Southern Association, said he should not like to see any abrogation of the rules that had been laid down for the conduct of the Association. There were many estimable members of the South-West Association that he liked to see at all times; but indiscriminate admission of members should not be allowed. He would second Mr. Broadberry's proposition.

The motion having been agreed to, the President, the Hon. Secretary, and Mr. Chapman were appointed the Committee to deal with the subject.

THE INCANDESCENT GAS LIGHTING OF WINCHESTER.

The HON. SECRETARY said that Mr. Dexter would make a short statement as to the adoption of incandescent gas-burners for lighting the streets of Winchester.

Mr. DEXTER said that, as the members of the Association were all no doubt aware, they were now actively engaged in changing the lighting of the streets at Winchester. They commenced making the alteration from oil to incandescent gas lighting on the 1st of November, when about one-third of the entire number of lights were changed in one evening; and they produced an excellent impression. On Nov. 5, they had about half of the lights in the city on the incandescent system; and if any of the members were passing in his direction during the next two or three weeks, it would be a good time to see the transition from oil to incandescent gas lighting. Even the powerful Bray lights in the refuge lamps looked quite dismal among the rows of incandescent lamps stretching down the streets at different angles. The public and the press all approved of the change. As to the behaviour of the lights in windy weather, he was glad to say that his undertaking to the Corporation, when the alterations were first made, that they would have no difficulty in maintaining the lights without failure—without being blown out, or made to duck in any way—had been fully fulfilled. On Nov. 5, they had extremely severe weather in Winchester. House roofs were stripped in many places; and a great deal of damage was done by wind and rain. A similar night also occurred on the previous Saturday (the 9th). But, on each of these occasions, not one of the incandescent burners was blown out by wind, and they all remained perfectly steady; whereas there were a great number of the oil-lamps out. This contrast had done more than anything else in showing that the city would be well repaid in making the change.

This concluded the business proceedings; and tea was then served to the members.

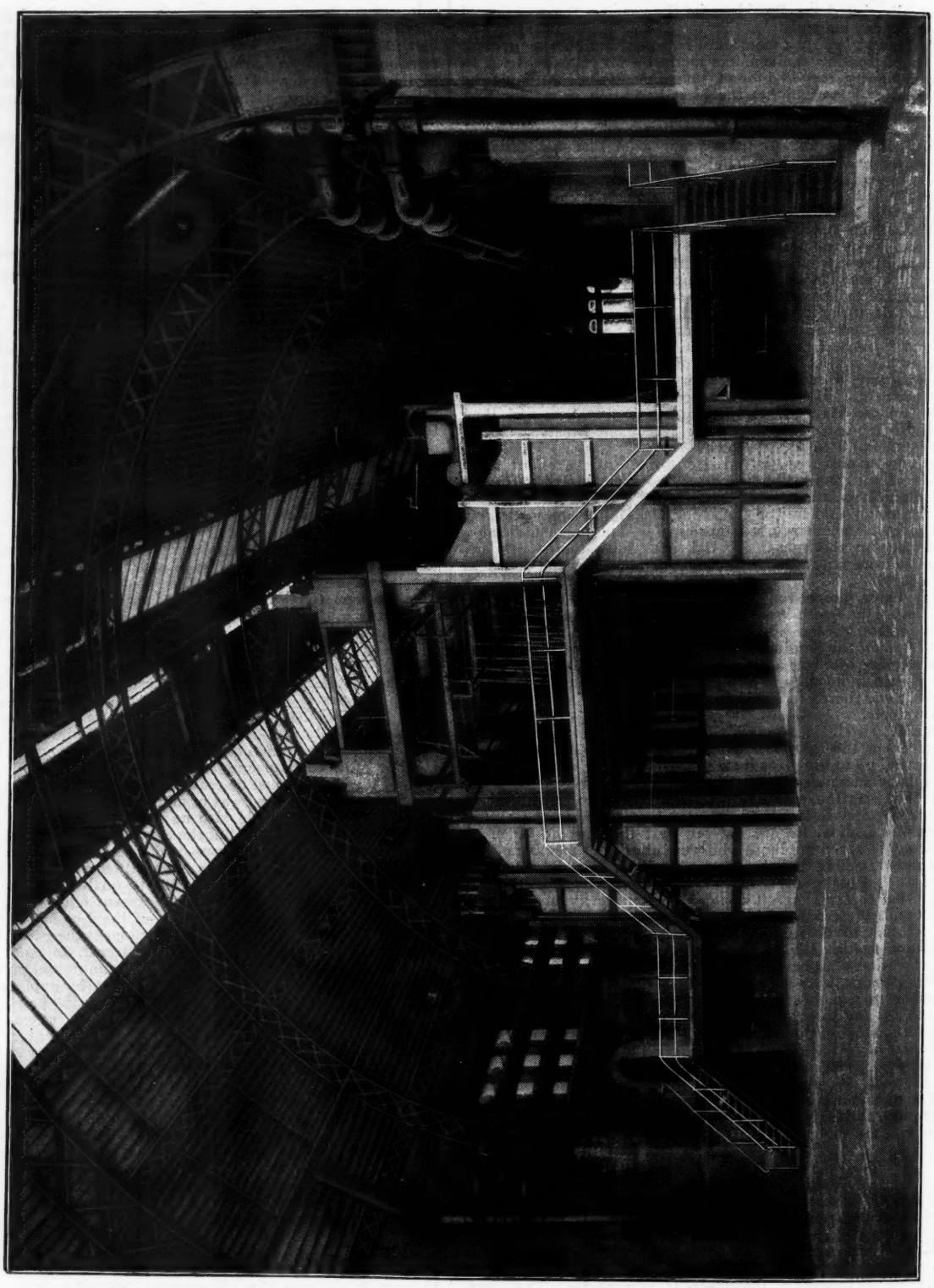
AMERICAN GASLIGHT ASSOCIATION.

Annual Meeting in Philadelphia.

The Twenty-third Annual Meeting of the above Association was held on the 16th, 17th, and 18th ult., under the presidency of Mr. WALTON CLARK.

After some routine business had been disposed of, the President delivered his Inaugural Address. With a brief introduction, he directed attention to their Association. A voluntary association, he said, was what the members made it; and if it fell short of the standard set by its founders and desired by its friends, they need not look beyond the rules, or the energy with which they were carried out, for the cause. He felt that the present efficiency of the Association fell far short of the standard set out for it; and he proceeded to discuss its conditions, and to offer some suggestions for its improvement. While the Association was to be congratulated on the papers presented at the meetings, the discussions were feeble. With a membership of about 400, he noticed that the last three years' proceedings included only 81 speakers; and of these only 34 had taken as many as three subjects. Only 8 per cent. of the members spoke as often as once a year. He believed there were two causes for this. The first was the lack of opportunity for a previous study of the paper read; and the second was hurry. Some attempt had been made in the way of issuing papers in advance; but he believed great difficulty was experienced in getting writers to send in their communications in time. He suggested that the present *Quarterly* should be abolished; and that the Secretary should print and issue every paper as soon as it had been received and approved—discussion being confined to papers that had been issued at least two weeks previously to the date of meeting. In place of the *Quarterly*, he would publish an annual report of the proceedings, as soon as possible after each meeting. The present rule seemed to be that all the papers must be read, whether discussed or not; but one paper well discussed was of more value than many without discussion. There should also be a systematic investigation of processes and apparatus; but the Association was not ready for this till it had a larger revenue, and could retain the exclusive services of its Secretary. The Association was doing nothing to help those who were struggling to qualify themselves for positions of responsibility, while at present filling subordinate situations in gas-works. The work of the London Guild was admirable, though scarcely sufficient to meet the case; but the Association could easily, and at a small cost, do something in this way. He recommended a Standing Committee on Education, to prepare a list of questions, which might be published with the proceedings, and prizes of books offered for the best answers. The Association should include all elements of strength in its membership, and exclude all others. The present rule was not a sufficient protection, as any man holding one of several described positions was eligible, even if unfit otherwise; and no man, however competent, could be admitted unless he held the position. Her ecommended an amendment making membership dependent upon ability and record, and not on present official position. Speaking upon federation, he offered no arguments for or against it; but he thought that the Association might secure all the benefits obtainable by federation, without the uncertainty that must follow any radical change in organization. At present, it commanded the experience and ability of the whole country; and all that was wanted was to devise and operate the necessary system. He proposed the appointment of Special Committees on Standards and on Research. The latter should be a standing one, and might have power to offer bi-annually the prize of a life membership and a decoration for the most valuable contribution based on original research. It was said that the Association was stagnating; and there was already some talk about founding another on broader lines. But while it could not be disrupted from without, it could not afford to ignore the fact that many of the strongest members were dissatisfied, and held aloof. The proper course would be to make the membership so valuable that no ambitious American gas man would be content without it.

The first paper taken was by Mr. W. H. Rogers, of Paterson (N.J.), entitled "The Creation of a Healthy Public Sentiment towards the Gas Company in the District in which it Operates." He defined a healthy sentiment as a belief that the company were honest, impartial, fair and square in their dealings, mindful of the rights of others, not wanting the big end of everything all the time, and not unreasonable or tyrannical. The public should be convinced that the gas company were as worthy of faith and confidence as any other honest dealer. Assuming that the working was in the condition usual in any modern gas-works, he enlarged on the importance of courtesy to all customers. He



RETORT-HOUSE AT THE HUDDERSFIELD GAS-WORKS.

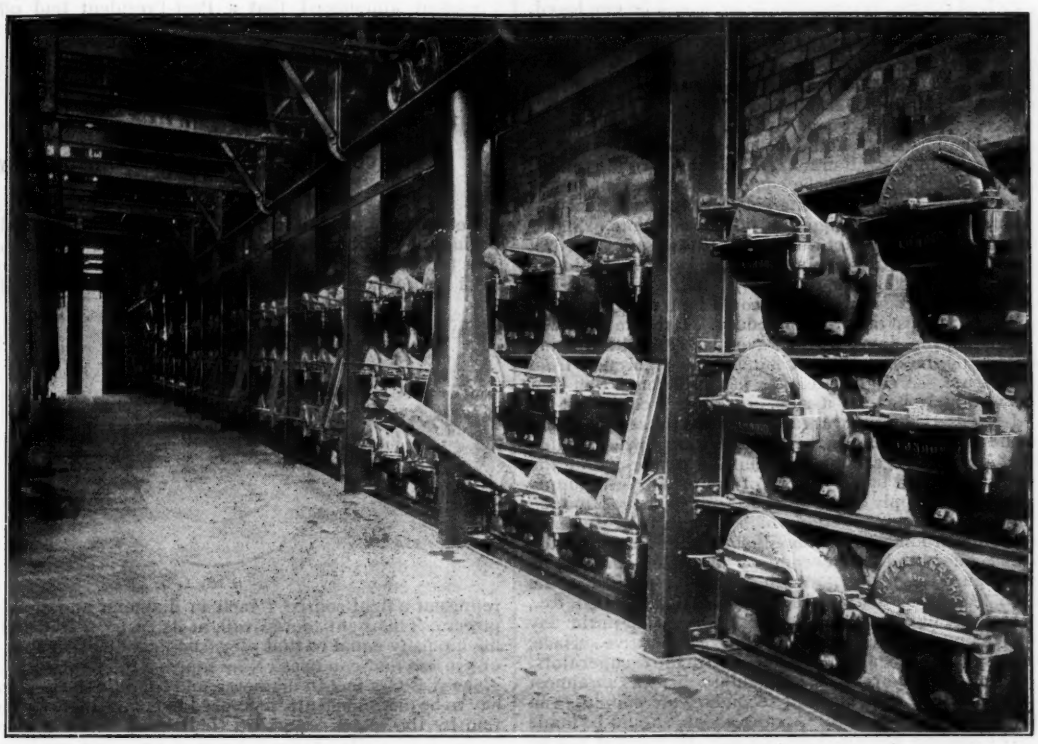
(*For Description, see p.* 1019.)

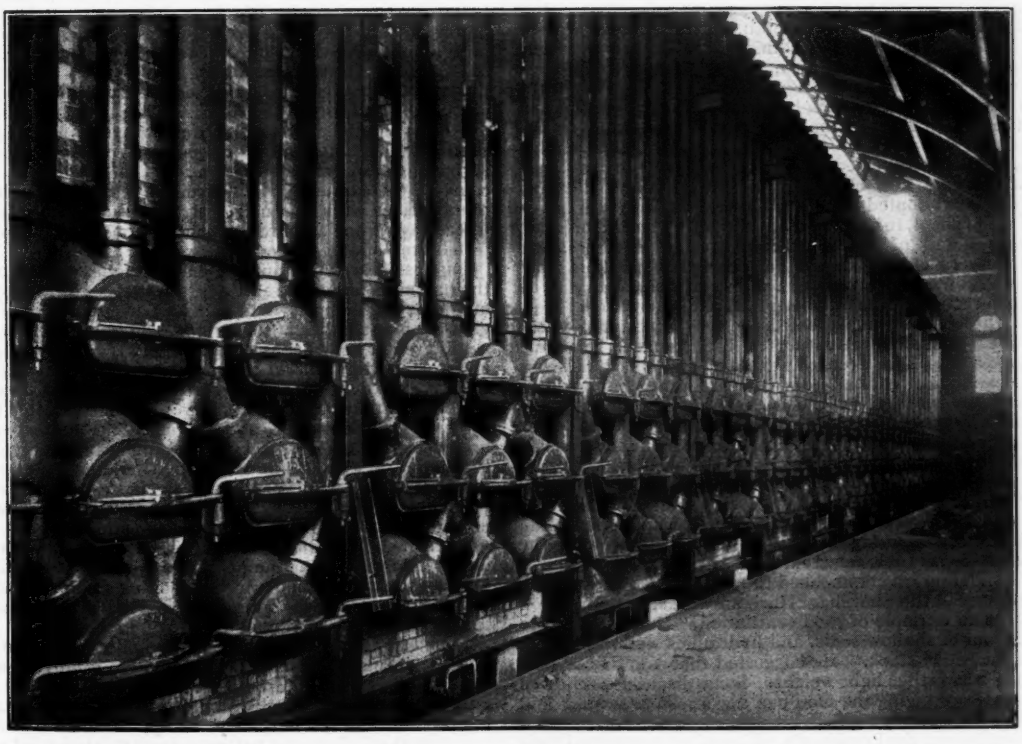
advocated getting business by fair means only, and the avoidance of adverse criticism on other competing forms of lighting. If electric meters were doubtful, and oil-lamps dangerous, the public would find it out without help. A mistake, if made, should be promptly acknowledged, corrected, and avoided in future. Discontented consumers, and the best ways of meeting their complaints, were next considered at some length; and the whole matter was summed up in the conclusion that, although gas companies have neither souls nor bodies, they are dependent for permanent success upon the same rules that govern the conduct of creatures possessing those attributes.

Discussion having been invited, Mr. M'Millin quoted some incidents from his experience, illustrating the necessity of maintaining cordial relations with the consumers. Gas companies should make just rules, and adhere rigidly to them. Mr. Greenhough supported the author in insisting on every effort to promote healthy public sentiment. In the larger cities, the official meter inspector was useful for deciding registration disputes. Some plan of municipal profit-sharing would prove the best antidote to the now common movement towards municipal ownership. Mr. Searle believed kind and considerate treatment would prove more conducive to the best interests of the concern than any system of profit-sharing. Mr. Somerville always thought it the best policy to do all he could to promote the interest and secure the satisfaction of his customers; and he believed that the steady growth of their business, in face of competition, was due to the fact that gas companies generally treated their customers with consideration and politeness. Mr. M'Millin agreed that it was often an advantage to give the city a bonus, or some share of the profits, as a consideration for granting the franchise; and he also advocated profit-sharing for the workmen. At Columbus, a dividend was paid to the employees on their wages, at the same percentage as that declared on the capital. It was not paid in cash, but in

SETTINGS OF INCLINED RETORTS AT THE HUDDERSFIELD GAS-WORKS.

(*For Description, see p.* 1019.)





stock, until the employee had acquired £60 worth of stock. Mr. Greenhough said that at Cleveland it had been suggested that there should be a payment of a percentage on the gas receipts to the city, and not a fixed sum. Mr. Norris saw no reason why the municipality had a right to gas profits any more than they had to those of any other trades. If the profits exceeded a fair percentage, the consumer and not the city should get the benefit; and there should be a reduction in price. Mr. Forstall remarked that the gas company were different from other manufacturers, because they received a franchise, for which some return might be claimed. Mr. Harbison preferred to give dividends to workmen in the form of increase of wages. He did not favour any scheme for sharing profits with the municipality, because gas consumers and taxpayers were not necessarily one and the same. The large proportion of local taxes paid by the gas company was a sufficient consideration for the grant of the franchise.

Mr. A. E. Forstall, of Newark (N.J.), read a paper on "Retort-House Design and Practice." He advocated making the retort-house large enough to admit of the use of machinery, and the provision of movable shutters, which could be opened or closed according to the direction of the wind. Openings in the roof near the eaves were objected to as likely to drive the smoke downwards. The possibility of extension at a future time should not be overlooked; and the arches should be wide—say, 10 ft. 6 in. clear for beds of nine, or 8 feet clear for beds of six. Wide furnaces prevented the fire from burning too low; and roomy combustion chambers were a *sine quâ non* for well-distributed high heats. The retorts should be of a size to enable the charge giving the desired yield to fill the retort as full

as was consistent with convenient drawing and charging. Large retorts run at low heats often gave more trouble with soot and naphthalene than the same retorts at higher heats with heavier charges; and, of course, regenerator firing would be employed. Stand-pipes should be at least 7 inches in diameter, and carefully laid out, so that the curves, where necessary, should be as easy as possible. The hydraulic mains should be large, and so arranged that the heavy tar could be easily removed while in operation, with adjustable overflow and a bottom outlet to each bench, and cross partitions so as to give each bench its own water-level. The furnaces should be air-tight, with the exception of the proper inlets—all cracks, &c., being carefully filled; and while any quantity of hot coke could be put in at one time, small charges of cold coke were the rule, leaving sufficient hot surface exposed to ensure the ignition of the carbonic oxide as soon as the air came in contact with it. If this was neglected, it was possible that the setting might be charged with an explosive mixture when the heats were low—as at first starting. The proper conditions for regular working could be tested by throwing a handful of coal dust in at the open door. If the damper was properly adjusted, the flame would waver lazily; neither being drawn steadily by the draught, nor flaming out vigorously from excess of pressure. A slight pressure in the furnace was best for economy of fuel; but, as a rule, good heats could not be maintained unless the pressure was cut down to zero. There should not be a decided pull on the furnace, except when getting up the heat without regard to consumption of fuel; and the heat should be adjusted by regulation of the primary air supply—the secondary air supply being proportioned to the production of carbonic oxide. The blue flame which indicates the presence of unconsumed carbonic oxide, should be quite absent at the outlet to the flue; and the secondary air-slides should be adjusted to secure this result. As the production of carbonic oxide varied according to the conditions of the fuel-bed, &c., from time to time, an exact adjustment for every hour in the day could not be maintained. Given a sufficient recuperative surface, the appearance of any heat above a dark red in the recuperators, below the point of entrance of the secondary air, was an almost certain indication of an insufficient secondary air supply, even though no flame could be seen. Arrangements should be made for properly clamping the air-slides, so that they could not be moved by accident; and their proper adjustment was a matter which should not be left to the average stoker or foreman. Not only must the fuel-bed be a good depth, but this depth must be uniform; and this could not be obtained without careful stoking back when the coke was drawn in, and by pushing to the back immediately before the draw. The better plan was to get the coke well banked up at the back before the draw, as the fireman was not then hampered by the presence of the shute or the falling coke. The work of clinkering the furnace, cleaning flues, &c., was next described in detail; and also the arrangements for drawing and charging the retorts, and cleaning stopped pipes, as adopted by the author at his own works. A specimen ruled sheet, to be filled up by the retort-house foreman, giving every detail of the work done during 24 hours, was exhibited. Every charge should be weighed, if possible; but frequently this was inconvenient; and it was necessary to be satisfied with recording the number of barrow-loads of coal used. A gang of three men was expected to work 27 retorts—three beds of nines—including attention to the furnaces, cleaning stopped pipes, &c. The average weight of coal per charge was 3 cwt.; so each man handled nearly four tons of coal per day. The retorts were cleaned by the natural draught through the stand-pipe; carbon tiles being laid to carry the air to the back of the retort, and the front being blocked up. The tar was run off from the hydraulics twice a day, and replaced with liquor; and this was attended to by a "topman," who also undertook scurfing retorts and other odd jobs. Every man was allowed a regular day off per week. There was a lengthy appendix to the paper, giving full working details of the construction of the various retort-house tools referred to.

Mr. G. T. Thompson commenced the discussion by describing the retort-house at the Shoreham Harbour works, near Brighton (England), as an example of good ventilation. He proceeded to speak in favour of shallow seals, and hydraulics well away from the top of the retort-stack. He suggested that 100 lbs. of coal to the scoop was rather light weight. Some discussion followed as to the policy of giving the men one day's rest in seven; and Mr. Forstall then briefly replied.

The Committee on the President's Address here presented their report, which was of a more important nature than usual, and embodied several innovations. They recommended that the *Quarterly* be abolished; that papers should be published to the members as soon as received and approved by the President and Secretary; that only papers so published at least two weeks previous to reading should be discussed; that an annual volume of Proceedings should be published; and "that the Council be authorized to include in the volume the proceedings of other Associations, if they deem proper, and can obtain from such Associations compensation therefor." They also advised the appointment of a Standing Committee on Education and a Committee on Standards, and the amendment of members' qualification, as suggested in the address. A supplemental report recommended that the Committee on Education should also be empowered to deal with research, and the offer of a prize for papers on research or invention. The Committee should not have power to deal with the funds of the Association for prizes; but would be open to receive special donations. These reports were adopted without discussion; and the President announced that a Past-President had offered the following sums for the prize fund: £20 for 1896; £40 for 1897; and £60 for 1898.

Mr. A. C. Humphreys, of New York, then read his paper on "The Commercial Value of Photometry."

(To be continued.)

THE COMMERCIAL VALUE OF PHOTOMETRY.

(Continued from p. 977.)

Let us see how this action of the eye comes in, when comparing the effect from two (hypothetical) arc lamps, one naked and the other enclosed in a translucent globe. Referring to fig. 1 [reproduced], let us suppose the small unlettered circle to

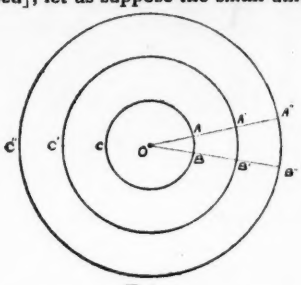


FIG. 1.

represent a light-source 1 inch in diameter and of 1000-candle power. This light-source will, at its surface, give an illuminating intensity equal to that of 576,000 candles at 1 foot distance, or 576,000 foot-candles. Now suppose the light enclosed in the globe A B C, 2 feet in diameter, and suppose the luminous intensity to be just sufficiently increased to compensate for the absorption by the globe. Now we shall have at the surface of the globe an intensity of illumination of 1000 foot-candles. Therefore the candle power and the illuminating intensity at any point are not altered. But how different must be the illuminating effect if the eye is permitted to receive the direct rays, as must almost necessarily be the case in general illumination? In one case, the eye receives direct rays from a light-source producing an illuminating intensity at its surface of 576,000 foot-candles; while in the second case, with equal illumination, the eye is only subjected to the direct rays from a light-source producing an illuminating intensity of 1000 foot-candles at its surface, for we may now consider the globe as the light-source. Or, expressing it differently, with equal intensities of illumination, with the naked light the eye must receive the direct rays from a source which has only 1-576th of the projected area of the shaded light.

Suppose that, when putting on the globe, we do not increase the luminous intensity, and say the globe absorbs 40 per cent. of the light; then the light will be 600-candle power, and only give 600 foot-candles at its surface. This will present to the eye a still greater contrast as to the direct rays; and we may readily believe that for general illumination, with the eye taking in all the surroundings, and therefore necessarily exposed to the direct rays, the shaded light of even reduced candle power will produce the pleasanter, and therefore the better, effect. If, however, it becomes necessary to examine any object closely and continuously, we shall find that, by shielding our eyes from the direct rays, and waiting until the eye has recovered from excess of excitation, that the naked light of 1000-candle power serves us better than the shaded light of 600-candle power.

Of course, in addition to the direct effect upon the eye, the larger light-source has the positive advantage of sending its converging rays in behind objects making shadows—producing a softer effect, and also again relieving the eye from sharp contrasts of intensity of illumination.

Even supposing we can correctly imitate the colour of sunlight, any source of artificial illumination, subdivide and distribute it as we may, must of necessity give imperfect results, if only on account of its lack of uniformity of intensity, through the operation of the law of the inverse squares. To take an extreme and hypothetical case to better impress this point, let us suppose we have two light-sources, an inch in diameter, and placed 400 feet apart, the intensity of illumination to be measured along the horizontal upon a vertical screen. We will compare the combined illuminating effect with that of 25-candle power light-sources of the same size, set 100 feet apart. A few selected combined intensities of illumination, expressed in foot-candles are given in the following table.

Cohn, an authority on hygiene, states that the illumination produced by daylight on a well-exposed table is equal to 4·6 foot-candles; and that the minimum required for reading and writing without undue fatigue is about 1 foot-candle. Wybauw gives as the minimum required for reading about 1 foot-candle; but for fluent reading, he says 1·4 to 2·3 foot-candles is required. And he gives as the minimum for street lighting 0·09 foot-candle. Professor Morton gives as the intensity of illumination at the back of a room, 20 feet from the

	1000 C. P. Lights, 400 Feet Apart.		25 C. P. Lights, 100 Feet Apart.
At the surface of the lamp	576,000·0060	..	14,400·00250
1 foot from centre of lights	1000·0060+	..	25·00255
10 feet " " "	10·0065	..	0·25300
20 " " " "	2·5069	..	0·06640
50 " " " " (midway between 25-candle power lights)	0·4081	..	0·02000
100 feet from centre (surface of second 25-candle power lamp)	0·1110	..	14,400·00250
200 feet from centre (midway for 1000-candle power lights)	0·0500	..	14,400·00250
Carried over from one lamp to the next	0·0060	..	0·00250
Mean intensity	256·0000	..	186·00000
Mean intensity, omitting from the calculation the intensity within sphere 1 foot radius—say, "reduced mean intensity"	10·7500	..	1·00+

window, with buildings opposite, from 1·75 to 2·25 foot-candles. The range for daylight, he states, will be very great; but the figures given are sufficient for easy reading.

By reference to the preceding table, we see that, if we could obtain from artificial light-sources a uniform intensity of illumination equal to the reduced mean intensity even of the 25-candle power lights 100 feet apart, we could have our streets illuminated sufficiently for reading. With the true mean, we should be flooded with light. Of course, in practice, the lights would be placed above the plane of the surface to be illuminated; and this would tend to make the intensity of illumination more uniform. But I purposely selected this case as showing the full effect of the law of distances.

In this connection, reference may be made to Professor Anthony's paper, "The Sub-division and Distribution of Artificial Sources of Illumination." Referring to the lighting of villages and suburban places by arc lights, he says: "A little spot 50 or 100 feet in diameter under each lamp is brilliantly lighted, while the more distant points are in darkness all the more profound from the loss of sensitiveness of the eye when in the strong light." Mr. Upton, in the course of the discussion upon the paper, said of the illumination of a building at the Louisville Exposition, it was possible "to illuminate a large exhibition building, so that it looked brilliantly lighted, with a very low grade of absolute illumination, because there was *no one spot which your eye looked at which made the rest look dark*."

In all this we are reminded that a weaker light-source, more efficiently distributed, and reflected with a view to uniform distribution over the plane of the surface to be illuminated, and in connection with more efficient diffusing surfaces, may give a final result much superior to that obtained from a stronger light-source improperly applied. This difference in favour of the weaker light is sometimes found as the result of accident. This should not be noted as an argument that the photometrically weaker light-source is in practice the stronger, but rather we should take the lesson that the stronger light might be made to give proportionately better results.

In our crude observations, we often deceive ourselves by crediting one of the light-sources compared with too great a candle power. With many, the tendency seems to be to at once doubt the accuracy of the photometer and everything connected with it. The photometer and its governing laws are not to blame if it is used improperly, and partial statements accepted as if they were complete.

See how this applies to the arc light, with its so-called 1000 and 2000 candle power. Professor Anthony says there is no 450-watt lamp in use which will give 2000 candles *in the direction of greatest intensity*, or which will give 500 candles when surrounded by a plain globe, and measured for general illumination. On good 450-watt long arc lamps, he never obtained but one measurement out of thousands made as high as 2000 candles. Mr. Pike, in the discussion of Professor Anthony's paper, stated that 1200-candle power lamps in every case ran below 450-candle power when measured spherically. Apart from the error introduced into our estimates by crediting too high a candle power to the arc, the variation in intensity with the direction is a most disturbing element in our rough calculations, for the reasons already referred to.

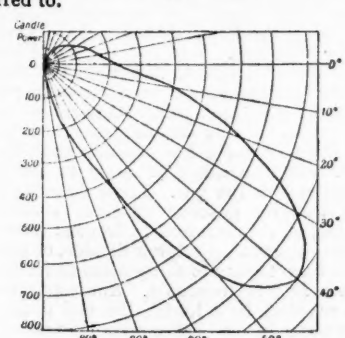


FIG. 2.

Fig. 2 shows the variation in the intensity of illumination from an arc lamp with the inclination, and is taken from the work of Professor Palaz. The diagram gives the result of all the photometric measurements made on continuous-current lamps at the Antwerp Exposition.

But the intensity of illumination also varies with the azimuth—that is, in any given plane, as we move around the lamp with it as a centre, its illuminating intensity will vary. Hence, to correctly state the value of an arc lamp, we must state it in mean spherical intensity. If we do not desire to illuminate above the lamp-plane, the efficiency can be increased by a proper system of reflectors. But the light, as a source, should be considered with regard to its mean spherical intensity.

The actual spherical distribution can be made to more uniformly conform to the mean spherical distribution by the simple addition of a translucent globe. Professor Palaz shows that while 15 to 60 per cent. of the total light may be so absorbed, the distribution is quite changed. He says: "The opalescent globe which surrounds the arc does not absorb the light uniformly. The luminous intensity of the parts of the globe which correspond to the maximum intensity is sensibly decreased, while that part which corresponds to the minimum is increased. The globe itself becomes luminous, and plays the part of a radiant."

Incandescent electric lights and flat-flame gas-burners also give considerable differences in spherical intensity; and Argand burners give different intensities for different angles of inclination. All these lights, when enclosed in translucent globes, also give a more uniform spherical distribution. Great stress is often laid upon the fact that a light, when enclosed in a translucent globe, furnishes a better result, and especially has "a greater diffusive power." Part of the explanation of this effect has already been attempted; and in this modification in the variations of intensity is found a further explanation.

In my paper of 1887, I detailed graphically and by tables the results of a long series of experiments on flat-flame burners; the candle power being taken horizontally for each degree between the edge of the flame and 90° (the flat of the flame), and for many different qualities of water gas; the variations being made by mixing carburetted and uncarburetted water gas in varying proportions. The most general practice at that time was to take the mean between the maximum (flat) reading and the minimum (edge) reading as the candle power. By the diagram showing my results was obtained the angle at which the burner would have to be placed to give a candle power equal to the mean of the maximum and minimum. This angle was found to vary, for the different gases, between 1·5° and 10·25°; and the mean of all the readings was 4·68°. A fairer method in each case would be to take the mean of all readings instead of the mean of the maximum and minimum.

In connection with these experiments, it is to be noted that the difference in readings between the flat and edge as a rule increased with the increase in the candle power of the gas; indicating a falling off in the transparency of the flames with the increase in density. Mineral-oil flames show still more strongly this absorption of light during its passage through its own flame; and this becomes very evident when testing large burners made up of a number of concentric rings.

Professor Mayer, in his paper "On the Illuminating Power of Flat Petroleum Flames in Various Azimuths," gives the results of his experiments with two types of petroleum burners—one the Hitchcock chimneyless air-blast lamp, and the other the ordinary lamp with chimney. With the Hitchcock lamp, the candle power from the edge of the flame was found to be 37 per cent. less than that from the flat; and with the ordinary lamp, the difference was found to be 38 per cent.

As bearing upon the question of the modification of spherical intensity by the use of globes, &c., Professor Mayer found that even a clear glass chimney had an effect. He says: "The flame of the Hitchcock lamp and the flame of the ordinary petroleum lamp with chimney increase in candle power with the azimuth in different rates. The reason for this is that the glass chimney acts as a reflector, and tends to equalize the illumination in different azimuths." Mr. Dibdin, in his "Practical Photometry," goes fully into the difference between the candle power of burners determined horizontally and spherically; and he shows his results by a number of diagrams.

Another source of error in our "practical" comparisons is in failing to keep in mind the (perhaps necessarily) arbitrary conditions imposed as to the standard burners to be employed in determining "candle power." If the standard burner gives a result not in accordance with the burners under observation, then to that extent are we astray in our premisses. This difference is sometimes in favour of, and sometimes against, the gas as ordinarily consumed.

Sheard's and Hinman's experiments show that a certain percentage of carbon dioxide will reduce the illuminating power of gas consumed in a flat-flame burner to a greater extent than if burned in an Argand burner. Here, then, two gases of equal candle power would give unequal illuminating effects if burned commercially in flat flames.

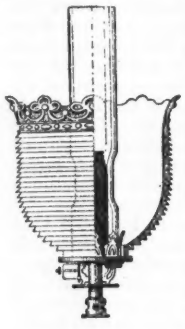
This lack of agreement is not due to any fault in the photometer, but to our arbitrary selection of a standard burner. The effect of carbon dioxide is less depreciating in the case of higher-power gas; and this difference between the candle power and the practical result would be eliminated, as the higher candle-power gases (in America, at least) are tested by the same burner most generally used by the consumer—viz., the flat flame.

(*To be continued.*)

THE FREDUREAU SYSTEM OF LIGHT-DIFFUSING GLOBES.

A desirable appanage for incandescent gas-burners is being introduced into the English and Colonial markets by Messrs. A. & E. Cohen, of Bury Street, St. Mary Axe, who are agents for the proprietors, the Société Anonyme des Globes Diffuseurs, Paris. These are a patented make of light-diffusing lamp-globes, or glasses, known in France by the name of the *système Frédureau*, These globes are manufactured of moulded glass, with a smooth inner surface, with the outside formed into concentric rings of prismatic section; the idea being to reproduce, in a cheap and suitable form for use with incandescent lights, the essential features of the dioptric lighthouse lenses of Fresnel. The angles of the prisms have to be carefully worked out with a view to the attainment of the object aimed at, which is to divert as many as possible of the upward and outward radiating rays of light from the source, and throw them downwards. If a transverse section of one of these moulded rings is examined, it will be seen that the upper side forms a segment of a paraboloid, the lower side being a plane. All these paraboloids are concentric with the globe; this centre being the focus of light. The effect of the addition of a glass so moulded to an incandescent gas-light is unmistakable. There is a notable increase of lighting effect in the region underneath the light, while much of the glare of an unscreened burner of the kind is removed. By a modification of the system, the globes can be adapted to act as projectors of light in a particular direction, for special purposes.

It will occur to our readers that this Frédureau system of globe moulding is somewhat similar to the holophane system already described in the JOURNAL (see Vol. LXV., p. 793). There is, however, this difference between the systems, that whereas the holophane globes are moulded with prismatic rings inside and out, the Frédureau globes are prismatic only on the outside. They are thus like a half of a holophane globe; and, of course, those who are interested in them aver that in this instance the half is better than the whole, inasmuch as the Frédureau system has the effect of bringing more light to bear in the desired direction. It does not, however, have the unique effect of the holophane system in so perfectly breaking up the rays of the light-source as to render direct vision of the latter impossible, and so exhibiting the phenomenon of a globe filled with light.



So far as the actual useful effect of the Frédureau system is in question, a report by Professor Silvanus P. Thompson ought to be regarded as satisfactorily establishing the point. He has made a series of photometrical tests of a 16-candle power incandescent electric lamp fitted with an upper hemispherical metallic reflector and a Frédureau diffusing globe. His report contains the following passage:—

> The lamp used was nominally of 16 candles; but, as is well known, incandescent lamps rated at 16 candles emit very various amounts of light in different directions, owing to the shape of the filament, and, when hung in the usual manner, usually emit much less light in the downward direction from the end of the lamp than they do in sideway directions. In the following table, the direction downward was taken as zero:—

Angle at which Light was Measured.	Amount of Light with Naked Lamp.	Amount of Light with Reflector only.	Amount of Light with Reflector and Diffusing Globe.
Deg.	Candles.	Candles.	Candles.
0	8·00	17·50	34·00
10	8·50	17·50	24·00
20	9·25	18·75	22·00
25	10·25	15·20	16·25
30	11·50	15·00	12·00

From this table it will be seen that the lamp, nominally of 16 candle power, was giving only 8 candles in the downward direction until provided with the diffusing globe and reflector; but when so provided, it gave a light downwards of 34 candles—being an increase of more than fourfold in the desired direction. This increase was, of course, obtained by utilizing rays that would otherwise be wasted by being emitted upwards, or in directions where they would produce little result.

It could have been wished that Professor Thompson had left out the upper metallic reflector altogether, and measured the useful effect of the diffusing globe without this appliance, which, it is hardly necessary to observe, has no proper place in the system, and is never employed where a general pleasing lighting is desired. It is impossible to accept without this qualification the statement that the downward lighting effect was increased "more than fourfold." All the same, the diffusing globes alone, as we have witnessed, do increase the lighting effect in the downward direction, and are therefore calculated to be useful in cases where this is desired. The system is applied in several shapes to incandescent gas-burners; the foregoing illustration showing one of the most ornamental patterns.

MODIFIED FORMS OF APPARATUS FOR GAS ANALYSIS.

Translated from the "Berichte" by G. E. Brown, A.I.C.

In a paper communicated to the German Chemical Society, Herr O. Bleier describes some original modifications of existing gas analysis apparatus, by means of which automatic measurement of easily and difficultly soluble gases can be effected. If the measuring-tube of a gas burette holds exactly 100 c.c., the simple passage of a gas through it is sufficient to measure off 100 c.c., as is done in Winkler's burette. By the use of this form of apparatus in preference to that, the measuring-tube of which holds more than 100 c.c., not only are much time and trouble saved, but a small error of observation is avoided in measuring the gas. Such gas burettes, with automatic measurement of the gas, can also be employed with water as the trapping liquid, even in the case of easily soluble gases. Following out this idea, the author has adapted Orsat's apparatus and Bunte's gas burette, and has also constructed a gas burette allowing the use of absorption pipettes after the well-known Hempel pattern.

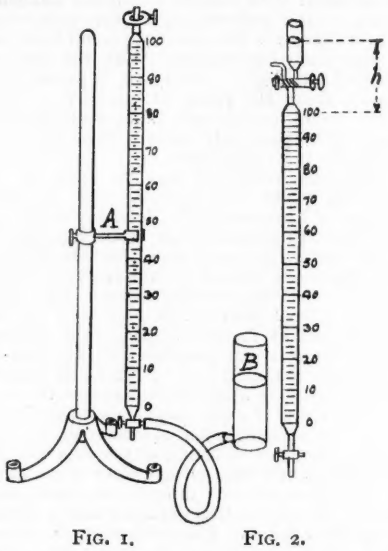


FIG. 1. FIG. 2.

The latter (fig. 1) consists of a measuring-tube A, which is affixed to an iron stand and a levelling-vessel B, connected to the measuring-tube by means of an india-rubber tube 110 cm. in length. The upper end of the measuring-tube terminates in a capillary tube (as in the Hempel burette), over which a piece of tubing is slipped, which can be closed by a pinch-cock. The lower extremity is provided with a three-way tap, through which communication can be made either with the capillary nozzle of the tap or with the levelling-vessel. The measuring-tube holds, from the plug of the glass tap to the end of the capillary tube, exactly 100 c.c., and is divided into $\frac{1}{5}$ c.c. The zero point of the graduation is at the lower end of the tube. The nozzle of the tap is made capillary in order that the water with which the tube is filled may take from two to three minutes to run out. Such a slowly sinking level of water carries with it most of the liquid adhering to the sides of the tube, so that a subsequent accumulation of the latter cannot take place. The bores of the three-way tap are not made capillary. The levelling-vessel holds about 150 c.c. It is made in any convenient form.

Manipulation of the Burette.—First turn the three-way tap so as to connect the measuring-tube with the levelling-vessel, which is filled with water, and, by raising the latter, fill the measuring-tube with water. Now turn the cock so as to connect the measuring-tube with the outlet-tube, and connect the tube carrying the pinch-cock with the reservoir holding the gas to be analyzed. If the pinch-cock be now opened, the gas will enter the tube, while the displaced water escapes below from the outlet-tube into a beaker. When all the water has been thus expelled, close the pinch-cock, and then the three-way tap. The short time which elapses between the closing of the pinch-cock and the three-way tap is sufficient to relieve any excess of pressure in the tube. Easily soluble gases must be allowed to pass through the tube for a few seconds after the water has been expelled, until the water adhering to the sides of the latter is saturated with the gas. From three to four seconds should be allowed for gaseous mixtures containing carbon dioxide, chlorine, or sulphuretted hydrogen; from eight to ten seconds for those containing sulphur dioxide, or gases of similar solubility; and from twenty to thirty seconds for those containing hydrochloric acid or ammonia. Annoyance from escaping gases can be avoided by allowing the end of the outlet-tube to dip into the water in the beaker standing under it.

Herr Bleier has introduced a very neat modification of Bunte's burette, by means of which easily or difficultly soluble gases can be automatically measured. The apparatus resembles Bunte's instrument in the main, and consists of a measuring-tube to which a glass cup is attached. The measuring-tube is closed at its upper

end by the two-way tap, proposed by Greiner and Friedrichs, and at its lower end by a single tap provided with a nozzle for the escape of water. This nozzle is made of fine capillary tube, so that the water takes from two to three minutes to run out. The space between the two taps measures from 100·7 to 101·0 c.c., and is divided into cubic centimetres and $\frac{1}{5}$ c.c. The 100 c.c. graduation is placed at the upper end of the tube; and above it the tube is contracted to a capillary. If the measuring-tube is filled with a gas under atmospheric pressure, and if, by turning the two-way cock, communication is made with the glass cup containing water up to a certain mark, then the gas in the measuring-tube will be compressed by the pressure of the column of water, the height of which is so arranged that a volume of exactly 100 c.c. shall result. The necessary quantity of water enters the measuring-tube, and runs down below the zero point of the graduation; so that for the tube to hold above its zero point exactly 100 c.c. of gas, which stands at the pressure under which all measurements are taken in the apparatus now under discussion—viz., under the pressure of the atmosphere *plus* that of the column *h* (fig. 2) of water—*h* must be so arranged that the pressure due to it exactly reduces the volume of the gas from 100·7 or 101 to 100 c.c. The exact value of *h* is determined empirically by the maker of each burette as follows: The water in the measuring-tube is allowed to escape, so that the latter is filled with air at atmospheric pressure. The lower tap is then closed, while the two-way tap is opened so as to connect the measuring-tube with the glass cup. Water is then poured into this cup until the level of the water which enters the measuring-tube coincides with the zero graduation. The level of the water in it is then scratched upon the glass cup; and in all subsequent measurements the water in the cup must stand at this level.

Manipulation of the Burette.—The gaseous mixture to be examined is allowed to displace the water from the measuring-tube, and then stream through the latter as explained when describing the first burette. The upper, and afterwards the lower, tap is then closed while the gas is passing through; and the glass cup is filled with the first absorption reagent to be employed. The two-way cock is turned so that the reagent slowly enters the measuring-tube. The liquid enters, first by reason of its pressure, and then in consequence of the reduction of pressure produced in the tube through absorption. The tube is well shaken until absorption is complete; the gas washed with a little water; and the volume read off. In order to absorb the next constituent of the gaseous mixture, place its absorption reagent in the cup, and, by opening first the lower and then the upper tap, allow the first reagent to escape from below while the second enters from above. Shake again; read off the volume; and so on. The first reagent may be sucked out before the second is allowed to enter, if the operator is satisfied that both taps close absolutely air-tight.

By this modification of Bunte's burette, analyses may be executed with great ease and speed, and with corresponding accuracy. Numerous analyses have been made by the author in both the burettes described. Since analyses of difficultly soluble gases are made commonly enough in such burettes some results obtained with easily soluble gases will, no doubt, be of interest. Analyses of an artificial mixture of air and hydrochloric acid gas are therefore subjoined (water being used as the absorption reagent):—

Experiment.

(1)	Analysis	25·8	per cent. HCl.		(4)	Analysis 25·6 per cent. HCl.	
(2)	,,	25·6	,,	,,	(5)	,, 25·6	,, ,,
(3)	,,	25·7	,,	,,	(6)	,, 25·5	,, ,,

The gaseous mixture was allowed to pass through the tube for 20 to 30 seconds after all the water had drained away. Similar results were obtained with sulphur dioxide and ammonia.

For storing easily soluble gases, a glass laboratory gasholder was fitted up, and, at the suggestion of Herr H. Kolb, a layer of paraffin about 4 cm. thick was allowed to float on the surface of the water. The paraffin was saturated by long shaking with the gases concerned, and was kept permanently in the gasholder. It rises and falls with the incoming or outgoing water, so that the same surface is always in contact with the gas. As shown clearly by the analysis of the gas given above, which was stored in such a holder, it is quite possible to keep a gaseous mixture of this description for some time fairly constant in composition.

MOVING WATER-MAINS WHILE IN USE.

At the Meeting of the American Society of Civil Engineers on the 2nd ult., a paper was read by Mr. E. C. Moore, in which he described the method adopted for moving two 36-inch water-mains without shutting off the service. The following is an abstract of the paper, the text of which appeared in the Society's "Bulletin":—

During the construction of the Lexington Avenue cable railway in New York City, it became necessary for the engineers of the Metropolitan Street Railway Company to move two 36-inch cast-iron water-mains without shutting off the water. These mains were laid in 1889, and were in 9-feet lengths. They had to be dropped for about 2 feet, and moved sideways about 1 foot for a distance of 100 feet; and for the same distance on either end of this section there was some shifting of position, so that the change in direction in passing from the old to the new location might be as gradual as possible.

The first work was to erect a yoke over each joint, from which the pipes could be hung by a chain and turnbuckles. The yokes were of 8 in. by 12 in. yellow pine, the posts being 8½ feet long, set on a wooden foot-block of 5 in. by 12 in. yellow pine 2 feet long, and the cap piece was about 11 feet long, being 9 feet between the posts. The cap was laid on top of the posts without framing, and fastened to them by 2 in. by 9 in. spruce cleats about 2 feet long; one being nailed at each post, and on opposite sides of the bent. Then a diagonal brace of 2 in. by 9 in. spruce about 3 feet long was nailed diagonally from the cap to each post on the opposite side to the cleat.

As soon as the first bent was set up and braced from the ground, the next was set up, and the two were fastened together by nailing two pieces of 2 in. by 9 in. spruce on the top, reaching from one bent to the other at the ends, and so on until twenty bents were in place. Then the chains, which were of ⅞-inch round iron, with links 7 inches long on the inside, were put in place. The part of the chain which went over the yoke was 5 feet long, and the part which went under the pipe was 11 feet long. There were two turnbuckles at each bent; so that the chain would not have to slip round the pipe or cap in lowering. Each turnbuckle was of 1¼-inch iron, with hooks on each end, and could lower 12 inches without changing hooks, which were made to just fit in the links of the chain. When the pipe was dropped as far as the turnbuckle would go, the latter was taken off in its turn, and the hooks placed in links nearer the end of the chain, when the lowering proceeded as before. Everything was made of sufficient strength to allow of every other turnbuckle being taken entirely off without in any way blocking the pipe.

The lateral movement of the pipes was accomplished by hanging the chains over the cap-piece, a few inches to one side of a perpendicular through the centre of the pipe, and putting a 4 in. by 6 in. spruce brace from the end of the cap to the bank, to prevent the bent from moving towards the pipe instead of the pipe towards the bent. At the same time, a 2 in. by 9 in. spruce brace was added at either end of each bent, running diagonally from the top of one to the bottom of the next, and in opposite directions at the two ends of the bents. This was done to take care of the torsional strain caused by the cap being at right angles to the pipe.

By beginning at one end, it was possible to lower the first 100 feet of the pipe into position, and to take down and move ahead the first eleven bents. Then, as the pipe came into position, each bent was taken down and moved ahead again. The two pipes lay parallel to each other and 5 feet apart, centre to centre. One pipe was lowered at a time. There was one hydrant connection in each pipe, which had to be cut in moving. Occasional small leaks occurred while the pipes were being moved; but they generally stopped as the pipe was lowered, and the joint had a chance to come back into its place. When the pipes were in position, all the joints were gone over and put in good condition. The work was carried on day and night, and cost about £1100.

The Latent Heat of Evaporation of Benzene.—This subject was dealt with in a paper, by Mr. E. H. Griffiths and Miss D. Marshall, read at a recent meeting of the Physical Society. The results arrived at by the authors were summed up in the formula: $L = 107{\cdot}05 - 0{\cdot}1581\ \Theta$, where Θ is the temperature, and the thermal unit at 15° C. is used.

The Examinations in "Gas Manufacture."—According to the report on the work of the Technological Examinations Department of the City and Guilds of London Institute for the year 1894-5, which has lately been issued, the number of entries for the examinations in technology in April and May last was 12,864; the papers actually marked being 10,293, as compared with 9907 in 1893-4. The number of passes was 5824—an increase of 343 on the previous year. In "Gas Manufacture," there were 96 candidates, of whom 60 passed. Their names will be found in the Journal for July 2 (p. 44). In the Honours Grade, 3 passed in the first class, 19 in the second class, and 18 failed; while in the Ordinary Grade, 12 passed in the first class, 26 in the second class, and 18 failed. Of the 96 candidates, 39 studied in class, and 57 were external; and the percentages of failures were 38·4 and 36·8 respectively. This was a rise, in the latter case, of 13·4 per cent. as compared with 1893-4. The Examiner (Mr. Alfred Colson, M.Inst.C.E., of Leicester) reports that, "while the work of the candidates was, on the whole, fairly satisfactory, it generally indicated an absence of an all-round training, or general knowledge of the subject." The drawings of apparatus called for were weak; and Mr. Colson advises students to learn to readily make clear and graphic sketches to illustrate their ideas, and to describe processes and apparatus concisely and lucidly. The following are the names of the prize-winners: Ordinary Grade—First prize (£1 and silver medal), A. E. Brooks; second prize (£1 and bronze medal), F. P. Tarratt; third prize (bronze medal), J. P. Hallaway.

REGISTER OF PATENTS.

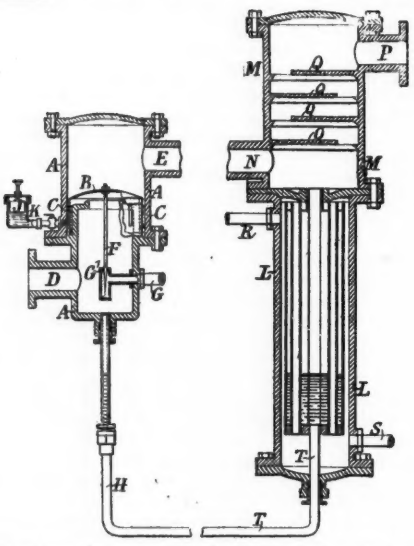
Increasing the Efficiency of Gas in Lighthouse Burners.—Wigham, J. R., of Dublin. No. 19,812; Oct. 18, 1894.

The object of this invention is to provide a method of rotating lighthouse lenses at such a rate that "the impression of the flash from one lens will not have left the eye of the observer till that from the succeeding lens reaches him; and thus the light is rendered continuous, never leaving the eye, while presenting a characteristic fluctuating appearance."

The method employed for the rapid rotation of the lenses is to fix them over a vertical spindle, with a case-hardened point working in a case-hardened socket, and the point surrounded by oil, for the purpose of lessening the friction. In some cases, where the weight of the lenses is very great, a chamber of mercury is used, for the purpose of diminishing the friction. The motion is communicated to the revolving apparatus either by the ordinary clockwork employed in lighthouses, or by a gas or petroleum engine. When gas is the illuminant used, there is combined with this arrangement a method by which the gaslight is intermitted so rapidly as to present its light continuously to the observer without sensible intervals of darkness; while at the same time the consumption of gas is diminished in proportion to the time during which the illuminant is not consumed. This is effected by valves, by which the gas is admitted to the burners for each lens or reflector, and shut off therefrom at the required intervals by means of a cam connected with the machinery by which the lenses or reflectors are rotated. The cam lifts a straight rod attached to the valve; and, in so doing, opens it for the passage of the gas. As it revolves, it closes the valve by the lowering of the rod; and thus shuts off the main supply of gas. A small bye-pass, however, maintains a very small, almost invisible light, fixed in the focus of each lens or reflector, so as to provide for its instantaneous re-ignition when the valve is again opened by the revolution of the cam. In the case of biform, triform, or quadriform lights, where two, three, or four vertically superposed lenses are used, this rod extends to all the burners, and opens and closes all the valves simultaneously, so that the flashes from the lenses form one unbroken beam (just as if they were emitted from one lens only), as at Galley Head, Mew Island, and Tory Island lighthouses. The valve is cylindric in form, divided in the centre by a diaphragm, on the under side of which is the entrance for the gas, and on the upper side the exit. In the diaphragm is formed a taper opening, which receives a disc of the same taper; both being ground in so as to be gas-tight. The disc is raised and lowered by means of the rod and cam already described; the rod passing through a stuffing-box at the top and bottom of the cylinder. The intermission may, however, be effected by simply rotating, by means of a belt or cog-wheel, the barrel of a ground-in gas-cock, having in the barrel the necessary number of slots for the emission of gas, and solid spaces for its retention.

Carburetting or Enriching Gas.—Tennant, P. C., and Hall, J. E., of the Gas Lighting Improvement Company, Bishopsgate, E.C. No. 20,253; Oct. 23, 1894.

This invention relates to means "for regulating or controlling the supply of various kinds of fluids, according to variations in the flow of gas which is to be carburetted thereby, or manufactured therefrom, or treated therewith"—the object being "to ensure that the quantity of liquid hydrocarbon admitted to the carburettor shall always be proportional to the amount of gas flowing through the same, and consequently the gas will always be uniformly carburetted or enriched, notwithstanding great variations in the quantity of carburetted gas being consumed."



The illustrations show a vertical central section of the regulating apparatus, and a form of carburettor to be employed in conjunction therewith.

A is a chamber, divided into two parts by a hollow float or bell B, partially immersed and floating in a mercury seal C. The chamber is provided with inlet and outlet pipes D E for the gas; the inlet being below, and the outlet above, the float or bell. The bell is provided with slots or with groups of perforations, so arranged that, when no gas is flowing through the apparatus, the openings in the bell will all be below the level of, and closed by, the mercury; and, when gas is flowing through the apparatus, the collective area of the openings above the level of the mercury will gradually increase or diminish as the bell B rises or falls in accordance with differences in the pressure of the gas. The gas to be enriched passes into the regulator A through the inlet D; and, by its pressure, raises the bell until the collective area of the openings above the level of the mercury is sufficient to allow the required amount of gas to pass without further raising the bell, and, after passing through such openings, the gas leaves the regulator by the outlet E.

The movement of the bell is utilized to open and close a valve for regulating or controlling, for example, the supply of liquid hydrocarbon to the vaporizer, according to the rate of flow of the gas through the carburettor and through the regulating apparatus.

The regulating-valve consists of a taper pin or rod F, depending from the hollow float or bell B, and extending through the mouth or aperture G^1 of a supply-pipe G, through which the liquid hydrocarbon flows from the store-tank, so that, when the valve is raised or lowered, it will regulate the flow of the liquid into the lower part of the chamber A. The chamber is provided with an outlet-pipe H for the liquid hydrocarbon, connected with the vaporizer.

To permit of adjusting the taper pin or rod F relatively to the aperture G^1, the patentees provide for raising or lowering the level of the mercury in the seal C, by means of a displacer or piston J, moveable in a small cylinder K, which can, when desired, be put in communication through a cock with the main body of mercury in the seal. Or this adjustment may be effected by raising or lowering the taper pin or rod relatively to the float or bell, by means of lock-nuts, adjusting screws, or other convenient devices.

The liquid hydrocarbon, as it passes through the aperture G^1, overflows into the lower part of the chamber A, whence it flows through the outlet-pipe to the vaporizer, passing on its way through a glass tube or other device, whereby the flow and level of the liquid may be observed.

The carburettor consists of a vaporizer L and a mixing chamber M above, connected by a pipe N with the gas-outlet E of the regulator, and itself provided with a gas-outlet P. The mixing chamber is, moreover, provided with baffle-plates Q, secured alternately to opposite sides of the chamber, so as to ensure the more effective mixing of the hydrocarbon vapour with the gas, and to arrest and return to the vaporizer any liquid that may be carried in suspension by the vapour from the vaporizer. The vaporizer L comprises a hollow cylinder, closed at its ends by tube-plates, and having tubes extending longitudinally through it; the cylinder being enclosed in a jacket or casing provided with inlet and outlet apertures R S, for the circulation of steam or any other heating medium. The cylinder is in direct communication at its upper end with the mixing chamber M; while its lower end is connected by a pipe T with the delivery-pipe H of the regulator.

The liquid hydrocarbon from the regulator flows through the pipes H and T into the cylinder of the vaporizer; and, rising in the same, it is heated by means of steam, hot water, or the like circulating around the cylinder and through the tubes. The liquid hydrocarbon is thus volatilized, and rises in the form of vapour into the mixing chamber M, in which the baffle-plates ensure its proper admixture with the gas.

In applying the regulator to apparatus for making oil gas, the patentees would intercalate the regulating chamber A in the pipe which conducts the permanent gas from the hydraulic main, or in the ascension-pipe which conducts the permanent gas and vapour from the retort to the hydraulic main; and then connect the pipe G with the oil-supply tank, and the pipe H with the ascension-pipe a short distance above the retort. With this arrangement, the flow of liquid hydrocarbon into the retort would be regulated according to the flow of the gas therefrom.

Tube Joints or Couplings.—John Brotherton, Limited, and Love, E., of Wolverhampton. No. 23,807; Dec. 7, 1894.

This invention relates to tube joints or couplings made without screwing the ends of the tubes, and in which loose collars placed round the tubes, and drawn towards one another at a joint by bolts, are made to bear against flanges on the tube ends, and thus tighten the flanges against suitable packing material. These joints or couplings require each only a single joint-ring of packing material, whatever pressure the joint may be intended to securely resist. The object is effected by placing a single packing-ring between the two opposing flanges of the tube ends, and surrounding the ring with a metal hoop or ring to prevent the packing ring being forced out from between the opposing flanges.

Gas-Engines.—Withers, S., of Holloway. No. 24,239; Dec. 13, 1894.

This is a vertical type of engine, having the cylinder inverted and supported on two standards fastened to, or cast with, the base or bed-plate which carries the crank-shaft. The gaseous mixture is admitted to the cylinder through an automatically acting valve in the top or inner end of the piston. The air is drawn in through a longitudinal recess in the side of the piston, communicating with the valve just mentioned; the gas being admitted to this recess (in order to mix with the air to form a gaseous mixture) through a passage in the side of the cylinder. The piston, with the recess in the side of it, is of sufficient length to always slide in register with the gas-passage during the whole or any part of the stroke of the piston. The valve for controlling the supply of gas is situated near the passage through the side of the cylinder; and an exhaust-valve near the end of the cylinder is used for discharging the products of combustion. For the operation of these valves, there is a rod situated in the same vertical plane as the cylinder and at the side. It is carried in guides affixed to the standards and cylinder, as may be found most convenient; being free to move up or down, and having tappets or strikers for operating the valves. The required motion is imparted to the rod by a cam revolving on a pin or bearing attached to one of the brackets or standards, and operated from the crank-shaft by tooth-wheel or other suitable gear in the proportion of two to one; thus giving it; the "Beau Rochas" cycle of operations. The rod has a friction-roller attached to its lower end, which bears on the periphery of the cam, and is caused to follow the curves on the cam by means of a spring.

The cycle of operations is as follows: On the piston commencing to make its downward or upward stroke, for drawing in a charge of

gaseous mixture, the valve in the piston acts automatically and admits air. At the same time, the cam, by means of a suitable curve, allows the valve-rod to slide in the direction for opening the gas-valve; and the striker on the rod for operating the gas-valve engages with the spindle of the gas-valve and opens it, allowing gas to mix with the air which is being drawn into the cylinder. (The method of regulating the supply of gas according to the power required from the engine is described later on). At the end of the out-stroke, the cam so operates the rod that the gas-valve is closed, and remains so until the next charging stroke. The piston now returns on the in-stroke, and compresses the charge; the valve in the piston being closed and kept so by the pressure in the cylinder. At the highest point of compression, the charge is ignited—preferably by an ordinary ignition-tube. The next out-stroke is the power or explosion stroke. Near the end of this stroke, the cam moves the rod in the direction of the exhaust-valve; the striker on the rod provided for the purpose engaging with the spindle of the exhaust-valve, and holding it open during the return or exhaust stroke. The opening of the exhaust-valve at or near the end of the power stroke, and the consequent release of the pressure in the cylinder, causes an influx of fresh air through the automatic valve in the piston to act as a scavenging or scouring charge (or stratum) to expel the products of combustion which would otherwise be retained in the compression space in the end of the cylinder. At the end of the exhaust stroke, the cam so operates the rod that the exhaust-valve is closed; while a further purging of the cylinder can be effected by holding open the exhaust-valve at the commencement of the compression stroke, by means of the cam and valve-rod, during which the piston travels inwards through a space approximating to the capacity of the compression space.

For the purpose of regulating the supply of gas to the cylinder, the striker for operating the gas-valve is pivoted from an arm which projects from the side of the valve-rod, in a manner and position suitable for suspending the gas-valve striker in vertical line with the gas-valve spindle, which is vertical or parallel with the valve-rod. Thus when the valve-rod moves in the direction for opening the valve, the striker presses endways on the spindle of the valve, and opens it. The end of the striker opposite to that which engages with the gas-valve spindle is extended for a short length beyond the pin upon which it is pivoted; and to this end is attached (preferably at a right angle) a vane or blade of thin sheet metal, which acts as follows: When the engine is running without a load, the impact of air on the side of the vane towards the direction in which the striker moves to open the gas-valve causes it to deviate from the vertical line with the gas-valve spindle, so that it does not engage with the spindle to open the valve. It passes by the side of it so long as an excess of speed is maintained by the engine; but when the normal speed of the engine is reached (either by a decrease of momentum, or by a load being put on it), the striker does not deviate enough from the vertical plane to disengage with the valve-spindle, and gas is admitted at each charging stroke, until sufficient impulses have been delivered to again raise the speed to the point at which the striker disengages with the gas-valve spindle.

Mixing the Gas and Air Supplying Incandescent Gas-Burners.—Denayrouze, L., of Neuilly, France. No. 14,053; July 23, 1895.

In his former patents—No. 7722 of 1895 and others—the inventor has described means for mixing the gas and air supplying burners of the Bunsen kind for incandescence gas lighting; and the present invention relates "to means of working the mixer in the form of a fan rapidly revolving in a chamber to which gas and air are admitted, and from which they pass intimately mixed to the burner."

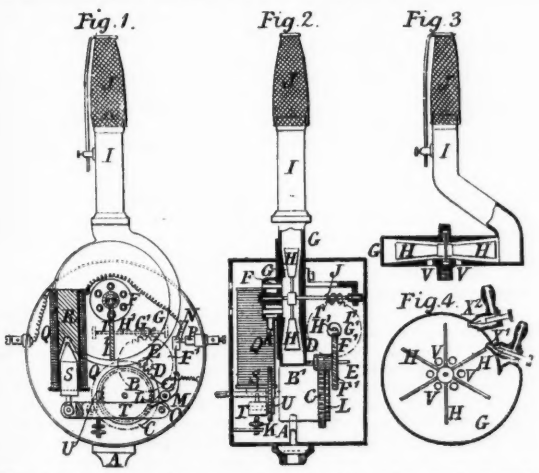


Fig. 1 is a front view (partly sectional), and fig. 2 is a vertical section, showing such apparatus driven by clockwork. Fig. 3 is a vertical section, and fig. 4 a sectional plan, of the mixing apparatus driven by the current of gas supplied.

In figs. 1 and 2, the gas passes by the conduit A to a chamber F, whence it passes by openings formed in the partition around the air inlet-tubes to the mixing chamber G, in which revolves the mixing-fan H, drawing in air while the gas enters with it. The fan is driven from a spring barrel B, a wheel C on which drives a pinion D on an axis E, which carries a worm-wheel F. This drives a worm G^1, on an axis H^1 carrying another worm-wheel I^1, which drives the worm J^1 on the axis of the fan H. This axis revolves on spring points; and the fan, revolving with great velocity, thoroughly mixes the gas and air, and drives the mixture into the burner-tube I, over which is the mantle J.

As the barrel B^1 revolves, the spring tends to become weaker, and would therefore drive the fan H more slowly; but this is provided against by winding up the spring as it unwinds, in the following manner: On the barrel to which the one end of the spring is attached, there is a ratchet-wheel L, with which engages a spring pawl lever M, terminating in a piece N, which, when the pawl enters a space between the teeth, makes a contact with P, by which an electrical current is transmitted to a solenoid or electromagnet coil Q. When the pawl is raised by a tooth of L, the contact of N and P is broken. On the axis of the barrel to which the other end of the spring is attached, there is fixed another ratchet-wheel K similar to L; and a lever T is provided, connected to an armature S, and carrying a pawl U. Whenever the magnet R is excited, it attracts S, raising the pawl U, and thus moving K a tooth to compensate for the wheel L turning a tooth. Thus, as the spring unwinds (turning L), the wheel K winds it up.

For starting the apparatus, the burner is provided with a gas-cock, by opening which a brake (not shown) is released, and an electric current is switched on. When the cock is closed, the brake is put on—stopping the mechanism, and switching off the current.

When the gas has sufficient pressure, it may be applied to drive the mixer, as shown in figs. 3 and 4. The fan H is fitted to turn freely in the casing G; its axis being preferably pivoted on jewels. Holes V near the centre of the casing admit air; while the gas enters through adjustable nozzles X^1 X^2 in jets, which act on the vanes of H, causing it to revolve, drawing in air, mixing it with the gas, and propelling the mixture up the burner-tube I. When air somewhat compressed is available, it may be sent through the nozzles X^1 X^2; the gas entering by central apertures.

As the pressure of the mixture issuing from the burner should be as low as possible, the utilization of the gas pressure in driving the mixer has (says the patentee) the advantage of producing the necessary reduction of pressure at the burner. In cases where the service gas has not sufficient pressure, an exhauster may be employed to raise the pressure; or air somewhat compressed (as mentioned above) may be applied to drive the mixer.

Gas-Fire Burners.—Sugg, W. T., of Westminster. No. 17,182 Sept. 14, 1895.

The object of this invention is to provide against the explosion and lighting back of gas-stove burners, by providing a bye-pass round the main cock to the burner, so that only a small quantity of gas will pass—sufficient to give a small flame at each jet, and by placing in the mouth of the jet a perforated steatite disc.

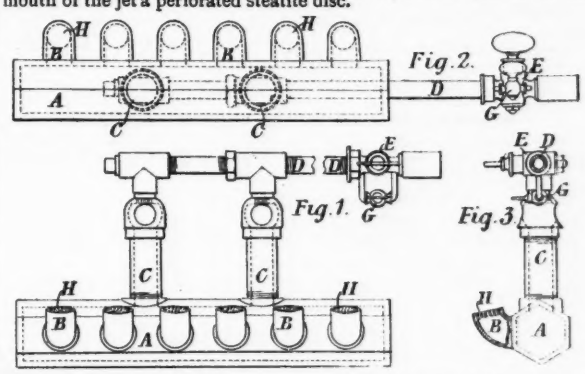


Fig. 1 is a plan of the burner; fig. 2, a back view; and fig. 3, an end view.

A is the burner, which consists of a long chamber, having elbows B, which form the jets or nozzles tapped into or cast with it. C are the mixing chambers for air and gas, of the Bunsen type; and D is the gas-supply pipe. In this pipe is the main cock E, round which is found the bye-pass G, also provided with a cock. In the mouth of each nozzle is a disc of steatite H, perforated with a number of small holes. The object of using the steatite is that, being a non-conducting material, it does not become red-hot by contact with the flame; and consequently there is nothing to light the mixture of air and gas, until it has passed through the disc, and comes in contact with the flame. The steatite also prevents the metal of the jets from becoming red-hot; and further, if the flame should try to pass through the steatite, it is cooled down at once and put out.

APPLICATIONS FOR LETTERS PATENT.

20,774.—Bryan, W. E., "Preventing waste of water and pipes freezing and bursting." Nov. 4.

20,801.—Morstein, O. Von, "Electrically lighting gas-jets from a distance." Nov. 4.

20,841.—Thomas, A. & P., "Automatic gas-pressure governor." Nov. 5.

20,889.—Harrison, E., "Asbestos fuel for gas-fires." Nov. 5.

20,964.—Marsh, T. G., Thorp, T., and Paterson, T. O., "Gas-condensers." Nov. 6.

21,060.—Schultze, W., "Air-heating apparatus for use in connection with gas cookers and for heating rooms." Nov. 7.

21,251.—Ives, E. W., "Sewage disposal works for towns, villages, and the like, draining into tidal waters." Nov. 9.

21,268.—Best, R. H., "Gas-lamps for photographic and other purposes." Nov. 9.

Gas Explosion at Primrose Hill.—About five o'clock last Saturday evening, an explosion of a somewhat serious character, followed by fire, occurred on premises of The Gaslight and Coke Company at Primrose Hill. It was afterwards discovered that a large gas-meter, of 500-light capacity, had been destroyed, and that a neighbouring brick and timber pit was in flames. The Marylebone and Paddington Fire Brigades were quickly on the scene of the conflagration; but, notwithstanding their exertions, the building and pit were destroyed.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

Price v. South Metropolitan Gas Company.

SIR,—I think those of your readers who are interested in the case of the Southwark Bridge explosion would like to know the facts, which were not quite correctly stated in the judgment on appeal, as reported in your last issue.

The 3-inch main was laid by the late Phœnix Gas Company prior to the amalgamation in 1880. It is close to the side of the macadamised roadway of the bridge; and at this point it is only 10½ inches deep, owing to a part of the structure of the bridge on which it rests being in the way. About a month prior to the explosion, the sewer contractors for the City made a small transverse excavation beneath the main, of which the Company did not know, nor had they any means of knowing. After the explosion, an escape of gas was traced to this point, when it was found that the earth had been loosely filled in—leaving the main insufficiently supported, while on one side it had the rigid support of the part of the bridge above mentioned. The main was found broken in two, with the fracture perfectly clean and bright. The Lord Chief Justice is reported to have said that this was "a crack of some two or three days' standing at the time of the accident." Where he gets this, no one knows; for there is absolutely no evidence whatever that the main was broken until the explosion took place. The ground was frozen; and the gas could not escape direct into the air. But it had, through the loose ground underneath, ready access to the electric light conduits, through which it was free to travel a long way in a very short time. At the trial, my brother did not say (as stated by the Lord Chief Justice) that rewards were given to the Company's employees for reports of disturbances of the streets—for that is not the case; but that the lamplighters were rewarded for reporting escapes of gas, which is a different matter.

The Lord Chief Justice also said: "The Company ought to have known of the disturbance of the soil." But how any gas company is to know when the scores of public bodies and the hundreds (in our case many thousands) of owners of property who have the right to open the streets without giving any notice to gas companies—and who, as a matter of fact, do make hundreds of openings in our district every day without notice to us—do so, is a point his Lordship did not condescend to explain.

GEORGE LIVESEY.

South Metropolitan Gas Company,
Old Kent Road, Nov. 16, 1895.

Keeping Up the Gas Supply Without a Gasholder.

SIR,—If your correspondent "Storage" will communicate with me, I will give him particulars of an instance of supplying gas to a town without the use of a gasholder.

G. E. STEVENSON.

Rochdale Road Gas-Works, Manchester,
Nov. 13, 1895.

[Since writing the above, our correspondent has promised to send the particulars referred to for publication in the JOURNAL next week, as they may possibly be of interest to others of our readers.—ED. J.G.L.]

A Hint to Sulphate Makers.

SIR,—Some of the buyers are trying to raise the 24 per cent. to 24½ per cent., which to me appears the thin end of the wedge. No doubt, 25 per cent. will follow, if not checked. We shall not get a penny more for it, but less; and no margin to speak of for moisture, &c. My advice is to ignore altogether any correspondence that asks for 24½ per cent.; it is in the makers' hands.

"ANTI BULL, BEAR, AND CO."

Nov. 15, 1895.

The Alleged Defective Reservoir at Millbrook.—Further discussion took place at a meeting of the St. German's District Council on Thursday respecting the alleged leaking reservoir at Millbrook. Mr. H. Masterton had forwarded the final settlement with Mr. Weldon, the contractor, the retention amounting to £315. Mr. Brown, a member of the Council, said that sufficient trouble was not taken in the first place to see that the reservoir was properly constructed. He had heard that it was built on a bed of springs. Mr. Banbury said the money had been paid for something which they had not had; and he could not believe there was no redress. The Chairman (Mr. R. E. Paige) suggested that a deputation should wait on Mr. Masterton before he signed the final certificate for the work, and lay the case before him. As soon as the certificate was signed, the contractor would have to be paid. This suggestion was adopted.

The Sale of Gas and Electricity at Blackpool.—During the year ending March 25, 1895, the number of gas consumers in Blackpool was 6200; and they used 235¼ million cubic feet of gas. In the 1400 public lamps, 15¼ million cubic feet of gas were burnt. The quantity of gas sold consequently amounted to 250⅜ million cubic feet; being an increase of 21½ millions on the sale the preceding year. There were 1¼ million cubic feet of gas used at the works; and the leakage amounted to 3⅜ millions, or 1·33 per cent. of the make, which was 255¼ millions. Our readers are aware that, in addition to the gas-works, which are under the management of Mr. John Chew, the Corporation own the electric light undertaking, the supervision of which has been entrusted to Mr. W. Chew. There were 172 consumers of electricity in the above-named period, and they took units equivalent to 15¼ million cubic feet of gas (reckoning 10 units as being equal to 1000 cubic feet). There were 94 arc lamps, which consumed the equivalent of 6½ million cubic feet. The consumption of electricity for these two purposes showed an increase equal to 15⅝ million cubic feet of gas as compared with the year ending March, 1894. On the works, there was used a quantity of electricity equal to half a million cubic feet of gas; and the loss of current in magnetizing, &c., was equivalent to 5½ millions, or 20 per cent. of the production. The total current was equal to 27⅜ million cubic feet of gas.

LEGAL INTELLIGENCE.

CROYDON QUARTER SESSIONS.—Wednesday, Nov. 13.

(Before Mr. R. G. GLENN, LL.B., Recorder.)

Croydon Gas Company v. Assessment Committee of the Croydon Union.

The hearing of the appeal by the Croydon Gas Company against the assessment of their property by the Assessment Committee of the Croydon Board of Guardians, which was before the Court on July 26 and 27 (see *ante*, p. 293), and was adjourned over the Long Vacation, was resumed to-day.

Briefly put, the case for the appellants was whether their assessment should not be £11,717 instead of £18,343 per annum. The witnesses examined in July were Mr. Ryde, who fixed his valuation at £12,573 (this figure having been arrived at from the audited accounts); also Mr. H. E. Jones, M.Inst.C.E., who put his at £12,800; and Mr. Corbet Woodall, M.Inst.C.E., a Director of the Croydon Gas Company, but who gave evidence in his professional capacity, who worked out his valuation at £12,825. At the close of the appellants' case, Mr. Littler addressed the Court for the respondents; maintaining that, instead of 17½ per cent., with 15 per cent. to cover everything, any commercial man of means would willingly take up the Company and work the business to a profit.

Mr. BALFOUR BROWNE, Q.C., Mr. DANCKWERTS, and Mr. BARNES again appeared for the appellants; Mr. LITTLER, Q.C., and Mr. E. PAGE represented the respondents.

Mr. LITTLER opened the proceedings by calling the Secretary of the Company (Mr. W. J. Russell) to produce their cash and bank books to show the receipts month by month for the year 1894.

Mr. Russell having appeared in the witness-box with his books, it was agreed, after contention between Counsel, that he and Mr. Mason should examine them together, and extract therefrom the requisite data.

Mr. *C. F. Jones*, F.I.S., a rating surveyor and valuer of 24 years' standing, said he had had considerable experience in valuing gas-works all round London, in Essex, and in Kent. He had surveyed the works at Croydon, having made a re-valuation of the whole undertaking on the Company's accounts for the half year ended Dec. 31, 1894. He had also made the valuation in the separate parishes in which the Company traded. The gross receipts from the sale of gas in that half year amounted to £78,875, and from the disposal of the residual products to £29,347; making a total of £108,222. Allowing for bad debts, he put the total at £108,034. He had valued meters and stoves at £17,700, as against Mr. Corbet Woodall's £20,900 for the same things. There were 52,645 tons of coal carbonized; and for that item he put £1754, against Mr. Woodall's £1500. Then there was a locomotive, which was a tenant's chattel; and for this he had allowed £400. As this was not included in Mr. Woodall's estimate at all, it would bring that gentleman's figures up to £1900 for tenant's chattels. He had allowed for six weeks' stock of coal as ample for all requirements, which would give £4653; and he had put down £4700. In this he was borne out by the fact that, in the busiest month of the year for the manufacture of gas, the appellants were satisfied with a stock of only £4334 worth; while in the summer months their stock was allowed to fall to the value of £937. The tenant's working expenses, *minus* rates (because he dealt with these separately), were in the same period £60,182. Four-and-a-half months' working expenses would be amply sufficient. This would give three months' credit and 1½ months in which to collect the accounts. He therefore allowed 18-52nds of the total tenant's working expenses, which worked out to £20,132. But meanwhile the tenant would be receiving cash for residuals; so he allowed 18-52nds of these receipts as taken. This showed that they would only want £10,862. Then they received cash deposits £1935; showing that the tenant's necessary capital for meeting current expenses was only £8927. But even this figure was too high. It had been stated that the Company had £5000 in the bank; but, in his opinion, there was no necessity for them to have any such sum. He considered an allowance of 15 per cent. on tenant's receipts ample for working expenses and other contingencies; for 15 per cent. on a capital of £36,500 would be a very good remuneration for him. After going *seriatim* through a mass of figures, witness concluded by stating that £18,343 was well within the rateable value of the appellants' property.

Mr. BALFOUR BROWNE cross-examined witness at great length; pointing out a series of arithmetical inaccuracies in the statements produced. In the main, however, Mr. Jones's evidence-in-chief remained unshaken.

Mr. *W. R. Chester*, M.Inst.C.E., the Gas Engineer of the Nottingham Corporation, stated that he had valued many gas-works for rating purposes. He had inspected the works and district of the Croydon Company; and he agreed generally with Mr. Jones.

Witness was subjected to a long cross-examination, which was mainly directed to showing how he arrived at his numerical deductions. He said he agreed that 15 per cent. was ample for tenant's profits, as stated by Mr. Littler in his speech for the respondents.

Thursday, Nov. 14.

The further hearing of the case took place at the rooms of the Incorporated Law Society to-day in London.

Mr. *W. Eve* was the first witness. He said he had valued gas-works in 130 parishes, many of which he enumerated. After making a complete survey of the appellants' property, he had come to the conclusion that 15 per cent. was ample to allow for tenants' profits. He went through a long series of figures to bear out his calculation.

Mr. *W. A. Mason* corroborated the evidence of the previous witness, having on the previous day examined the appellants' cash-book.

Mr. LITTLER then summed up the case for the appellants at considerable length, contending that they were entitled to 17½ per cent. for tenants' allowances.

Mr. BALFOUR BROWNE followed on the other side; arguing that the respondents were only entitled to allow the appellants 15 per cent.

The Recorder reserved judgment.

THAMES POLICE COURT.—Thursday, Nov. 14.

(*Before Mr.* DICKINSON.)

The Quality of the Commercial Company's Gas—The "Candle" Question.

To-day an adjourned summons was heard against the Commercial Gas Company for supplying gas of less illuminating power than it should be under their Act of Parliament. There was also a new summons for a similar offence.

Mr. BERRY, who prosecuted on behalf of the London County Council, said the offence referred to in the first summons took place in April, 1894. Certain proceedings with regard to that case had since been taken in the High Court;* and as, he believed, it would not now be contested, he would leave the matter in the hands of his Worship.

Mr. CHANCE, who appeared for the Company, said his clients would plead guilty to both summonses, as there was a technical deficiency. But he should like to say a few words as to the candles used. Up to December, 1893, there had been in use a certain standard candle, which had been made in accordance with the Act of 1875. That kind of candle was used for many years; and it was found to be extremely unsatisfactory and variable. In the above-named month, the Metropolitan Gas Referees issued a "Notification," providing for the manufacturing of what it was hoped would turn out to be a more satisfactory candle. But the makers were unable to produce it. In March, 1894, another "Notification" was issued, increasing the maximum weight of the wick; and efforts were again made to meet the provision, but without success. The Referees afterwards abandoned the question of manufacturing a fresh candle; and at the beginning of the present year candles were made in accordance with the original "Notification." The Company now supplied the candles; and he believed it would be admitted that the one used in 1894 was one of the old candles tabooed by the Referees. He quoted statements showing that considerable confusion existed in the mind of the examiner as to which candle should be used. A new standard had now been agreed upon; and it was only awaiting the sanction of the Legislature. Under these circumstances, he asked for a reduced penalty.

Mr. DICKINSON said that, though on one point the penalty of 40s. was absurd, after what Mr. Chance had put forward in favour of the Company, he should only impose a penalty of 30s. and 2s. costs in one case, and 35s. and 2s. costs in the other.

The Alliance Gas Company and the Dublin Corporation.

In the Chancery Division of the High Court of Justice in Ireland last Tuesday, before the Master of the Rolls, the Solicitor-General applied, on behalf of the Alliance and Dublin Consumers' Gas Company, for an order that the Corporation of Dublin be attached for non-compliance with his Lordship's order of July 6 last (*ante*, p. 144), or, in the alternative, that a term might be limited for compliance with that judgment. His Lordship had directed that the defendants should remove all defective meters from the public lamps, and provide in lieu thereof proper meters within the meaning of the award, for the purpose of ascertaining the consumption and rate of gas supplied by the Company. Nothing had since been done; but, in the correspondence which had passed, the Corporation said they had placed the case before Mr. Serjeant Campion, to take his opinion as to whether they should appeal. The Company did not wish to appear harsh; and they were willing that the defendants should have a further three months to do what his Lordship had directed. Mr. C. O'Connor, Q.C., for the Corporation, said it was very difficult to ascertain within what time the change could be carried out, giving the Corporation credit for the utmost expedition. He would suggest that the motion should be allowed to stand over, with liberty to the plaintiffs to re-enter it if they were not satisfied with the steps the Corporation were taking in the meantime. This was agreed to.

The German Incandescent Gas-Light Company's Patents.

Our readers will doubtless be interested in the following particulars with regard to the proceedings which have lately taken place in the German Patent Office in reference to the Welsbach patents for incandescent gas lighting: The German Incandescent Gas-Light Company, who may be called for brevity the "German Company," brought an action against several firms, who may be shortly referred to as the "other Companies," for an injunction to restrain them from infringing the Welsbach patents. These Companies retaliated by bringing an action in the German Patent Office against the German Company for the purpose of nullifying those patents, on the grounds that they had been anticipated, were without novelty, &c. The case was heard on the 7th inst. The Court found in favour of the German Company; and the demands for nullity and revocation of the patent were rejected. The plaintiffs—viz., the other Companies—had to pay the costs and three-quarters of the extra-judicial charges; the defendants (the German Company) had to pay one-quarter of the extra-judicial charges for the following reason: The Court found that the original Welsbach patent of 1885 was to be upheld in its entirety. This patent covers the method of construction of the mantle and the materials employed; so that the whole basis of the patent has been declared good and valid, the anticipations brought by the other side against it have been rejected, and the soundness of its claims has been enforced by a decree of the Patent Office which is the Supreme Court on the validity of patents in Germany. There was, however, a second patent (No. 41,945), the third clause of the claim of which specifies the use of one of the ingredients alone. The Welsbach patents generally claim the materials used either alone or in combination. But the wording of the German patent No. 41,945 is somewhat obscure; and it was held by the Patent Office that these materials could only be used in combination. Hence the third clause of that patent was struck out, as the materials had never been used singly. It may be explained that mantles can be made with these materials, whether they are used in combination or singly; but the best results can only be obtained by using them in combination. The result of striking out of the German patent the use of the materials singly in no way prejudices the German Company, inasmuch as no mantles made of a single substance have any chance of competing with those made of combinations; and special combinations such as are adopted by the Incandescent Companies are those which give the highest results. The judgment went at some length into the alleged anticipations, and showed that none of them had any practical bearing on the question. After dealing with the third claim of patent No. 41,945, as above stated, the judgment runs as follows: "Otherwise the demands for nullity and revocation were rejected." The reasons for this are then given as regards nullity. As regards revocation, the judgment states that "under no point of view could there be found any reason for revoking the patents." Therefore, the finding in this case may be summarized as follows:—

(1) The original and principal patent of Dr. Carl Auer von Welsbach is upheld in its entirety; thus giving the Welsbach system the monopoly of the construction of the mantle with the materials mentioned.

(2) None of the anticipations brought against it were found to have any practical value or bearing upon the case.

(3) The Court held that clause 3 of the claim of the additional patent No. 41,945, where the materials employed were claimed singly, must be annulled. This decision was arrived at partly because the use of the materials singly had never been carried into effect, and would never be carried into effect, as the results are inferior to those obtained by using the materials in combination; and, further, the finding of the Court was arrived at upon this point because the wording of the German patent is peculiar in this respect.

The general result of this finding of the Judges of the Imperial Patent Court is of the highest value to the German Company, and also indirectly to the other Companies who are working the Welsbach patents. The decision, brought about after a most severe fight on the opponents' side, proves conclusively that the German Patent Office holds Dr. Auer von Welsbach as the inventor of the system called after his name.

Defective Water-Fittings.

At the Lambeth Police Court last Friday, the Secretary of the Southwark and Vauxhall Water Company was summoned by James Barrow for neglecting and refusing to furnish a supply of water to his premises, No. 86, Fenwick Road, Peckham, during a part of the time for which the rates for the supply had been tendered. Mr. Lynch appeared for the Company. The complainant, Mr. Barrow, is the owner of the premises in question, which are within the district supplied by the defendants. At the beginning of October, the Company complained that the pipe serving the house was leaking; and considerable correspondence ensued between the parties—the complainant asserting that the damage to the pipe was caused by the Company's men probing the ground for the purpose of ascertaining the depth of the main. The Company, on the other hand, suggested that the fracture was caused by the frost; and they threatened to cut off the supply unless the complainant had the pipe repaired. Mr. Barrow replied that, the Company's men having damaged the pipe, the Company must themselves repair it. The Company, however, cut off the supply on Nov. 4, and the complainant then took out a summons. On behalf of the Company, Mr. Lynch contended that it was immaterial how the damage to the pipe was caused. Mr. Barrow, as the owner, was the person liable for its repair. Mr. Denman did not think the complainant could succeed under the summons, for various reasons. The Company were only bound to supply water so long as the fittings were in such a condition that the water could reach the house without danger of waste. In this case, the pipe was admittedly faulty; and he thought the Company were justified in cutting off the supply, the owner having failed to repair it. The summons was dismissed.

The Sandwich Corporation and the Gas-Works.—The Sandwich Town Council have agreed to purchase the undertaking of the Sandwich Gas Company at a valuation; and the ratepayers have sanctioned the promotion of a Bill to enable the agreement to be carried out.

Slough Gas Company.—The expenditure incurred by this Company in the enlargement of their works and plant and extensions of mains during the past five years, has necessitated the raising of further money; and the shareholders have, in consequence, empowered the Directors to increase the capital to "the amount authorized by the Company's Act of Parliament."

Singapore Gas Company, Limited.—The Directors of this Company report that the revenue for the six months ending June 30 was greatly influenced by the exchange, which averaged 2s. 1¼d. per dollar—a rate unprecedented during the existence of the Company. The accounts have been closely collected; and the works, under Mr. H. W. Smith's management, have been kept in good order and repair. At the meeting in May last, the Directors felt confident that they would be in a position this half year to recommend a dividend; but, in the face of a lower rate of exchange and a greatly increased cost of coals, they are again reluctantly compelled to advise that the balance of £1089 12s. 6d. be carried forward.

Torquay Water Supply.—An inquiry was held last Thursday at Torquay, by Colonel J. Ord Hastead, R.E., on behalf of the Local Government Board, respecting an application by the Town Council for power to borrow £4500 for works of water supply. It was explained by the Town Clerk (Mr. F. S. Hex) that the money was required for an extension of mains. An additional supply-main had been laid from Chapel Hill to the Warberry reservoir at a cost of £2644; the work having been done last winter to afford occupation for the unemployed in a period of exceptional distress. The other items were £304 for an additional supply-main from East Street to the service reservoir at Newton Abbot, £711 for the extension of the principal main at the intake at Tottiford to the storage reservoir, and the balance for additional mains at Cockington and in Torquay. Plans for the works were produced by Mr. T. S. Weeks, the Water Engineer.

* See JOURNAL, Vol. LXV., p. 755.

MISCELLANEOUS NEWS.

ELECTRIC LIGHTING NOTES.

The report by the Chief Clerk on the work of the Electricity and Public Lighting Department of the St. Pancras Vestry during the year ending May, 1895, was presented to the Vestry last Wednesday. The writer (Mr. A. E. Pycraft) sketches the progress of the work from the initial installation; and he remarks that the total number of consumers to May, 1895, was 373, representing 16,751 incandescent lamps of 16-candle power, 129 arc lamps, and 27 motors. The "large increase in the demand for supply, particularly that to private residences," he regards with satisfaction; and he confidently looks forward to the great impetus that will be given for a supply of current for cooking and heating purposes when the various electrical appliances are reduced in price. A table shows the increase in the sale of current at 3d. per unit to be 212 per cent. from January, 1894, to January, 1895; the cost of generating each unit sold, 2·060d.; the cost of distributing, 0·610d.; and the cost of management and general expenses, 0·565d. These charges, together with interest, repayment of loans, &c., make the total cost per unit 5·053d. Later, Mr. Pycraft recapitulates the report as to the electric lighting accounts furnished to the Vestry in March last, and epitomized in the JOURNAL at the time. The gas lighting section of the present report occupies only two pages out of the nineteen over which it extends; and the following particulars of the older illuminant are supplied. There are 4309 lamps in the parish, consuming an average of 4·64 cubic feet of gas per hour. In 1893, the average was 4·67 feet; and Mr. Pycraft says the present reduction in consumption "shows that the regulation of the governors has been attended to with greater care—thus producing the satisfactory results recorded." The reduction of the number of complaints from 44 to 14 is highly satisfactory—a more efficient result can, he says, scarcely be expected. The report also furnishes a proof that the electric light is not damaging the public gas lighting to such a degree as the friends of the former illuminant are apt to maintain, for reference is made to the "constant demand for more light," which has to be met. "Prior to 1874," the report continues, "the consumption was 5 cubic feet of gas per hour; by the meter system it has been reduced to an average of 4·6 cubic feet." The total amount paid to the Gas Company for the year ending Lady Day last was £8870 4s. 3d. On the same occasion, the Electricity Supply Committee reported that, pursuant to the Standing Orders, the Vestry had considered the communication from the Board of Trade, forwarding a copy of a letter received from a consumer respecting the supply of current at 220 volts. After being pressed for a reply, the Committee informed the Board "that no immediate change of pressure on the old mains will be made. It is proposed, however, to couple all new customers to the 220-volt distributors; and when it is found desirable to re-arrange the pressure on the mains, or to supply an old customer at higher voltage, the requirements of the St. Pancras (Middlesex) Electric Lighting Order will be fully complied with. If the Board deem it desirable that some form of notice or other action be observed, the Vestry will take any steps the Board may require in the matter." This letter was approved by the Vestry with but little discussion; but when the question of wages for the men working at the King's Road station was reached, a lively scene occurred. It appears that Mr. Baynes, the Chief Electrical Engineer, had written to the Resident Engineer ordering him to abolish double pay for overtime, and pay only the ordinary wage. Mr. Phillamore, the labour leader of the Vestry, was quite indignant at this; and he moved that the Vestry express regret at the action of the Chief Electrical Engineer without consulting his Committee. Mr. J. Dixon defended this official, who, he said, ought not to be continually interfered with. Mr. M'Gregor made his usual emphatic protest against the gross mismanagement of the Committee; and Mr. Gell complained of the low wages paid to the men. Eventually, Mr. Phillamore withdrew his motion. But the Vestry showed their disapproval of their Engineer's action by deciding that time-and-a-quarter should be paid up to 8 p.m.; time-and-a-half up to 10 p.m.; and after that double-time; while wages were practically raised all round. The ratepayers will note with interest that the Committee "are aware that the increase in wages and the other privileges will probably add to the cost of producing the current; but they believe they are acting in unison with the desire of the public and the Vestry in recommending them."

It will be remembered that the Hampstead Vestry recently asked the London County Council whether they would at an early date receive back the outstanding balances of loans advanced at rates of interest varying from £4 2s. 6d. to £3 10s. per cent., and amounting to £122,514, and re-lend this amount at 2⅞ per cent. interest; and whether they would advance a further sum of £24,270 to enable the Vestry to repay the Prudential Assurance Company the outstanding balance of a loan. The reply received from the Comptroller of the London County Council was to the effect that the Committee could only recommend the Council to accede to the first part of the request upon the Vestry undertaking to pay to the Council the loss which would accrue to them by accepting such a reduction in interest as that proposed; that the loss in respect of one loan—viz., that of £20,000 advanced in 1889 for 50 years at 3½ per cent., and on which there are still to be paid 44 annual instalments of £400 each—had been calculated as an example, and that the present value of that loss amounted to £1696 4s. 7d. The Committee had no objection to recommend the Council to advance a sum for the purpose of repaying a loan, when it was to the advantage of the Vestry to do so, subject (1) to the term for the new loan not being longer than the remaining part of the term of the original loan; (2) to the satisfaction of the Solicitor upon legal points; and (3) to the Council having parliamentary power to advance the sum required. As to rate of interest, it would be that charged by the Council at the time of the sanction; the present rate for such a loan being 2⅞ per cent. This practically means that the Vestry would be in no better position than heretofore; and the Finance Committee, to whom the matter was referred for consideration, will undoubtedly report to that effect. The Electric Light Committee will then have to find some other way out of their difficulties.

The Bangor City Council, like the Wimbledon District Council, seem determined to force the electric light upon the ratepayers in face of all opposition. We recorded last week (p. 984) how a meeting had been held, under the presidency of Dr. Emyr O. Price, to protest against the course adopted by the Council, and calling upon them to defer any action in the matter of electric lighting, beyond securing the necessary powers to proceed, and to take no further steps without consulting the ratepayers assembled in public meeting. This resolution was presented to the Council on the 9th inst. by Dr. Price; but the Deputy Town Clerk advised that it could not be read. Petitions against the action of the Council were laid before them by the representatives of several of the wards; but they were simply laughed at. At the same meeting, a proposition by Dr. Rowland Jones to rescind the resolution committing the Council to the electric lighting scheme was, after a discussion of nearly four hours, rejected by 13 votes to 8. In consequence of all these things, the opinion is freely expressed by the ratepayers that a majority of the Council have "taken the bit between their teeth," and are determined at all costs to impose upon the town a scheme which the ratepayers have condemned. With a view to impressing upon the recalcitrant majority in the Council the fact that that body does not exist to impose its own whims, or the fads of any section of it, upon the town, in opposition to the expressed wishes of the ratepayers, a requisition is to be presented to the new Mayor (Mr. J. E. Roberts), calling upon him to convene a public meeting of ratepayers to pronounce a further opinion on the subject. The dispute has now reached a stage at which it is not so much a question of whether the electric lighting scheme is good or bad, but whether the Council are to set at defiance the predominating wish and determination of the burgesses. We await the issue with much interest.

The Corporation of Harwich have lately been agitated on the subject of the public lighting of the town, for which at present oil is employed. The matter was referred to the Public Health Committee, who, at the last meeting, brought up a report containing the following statement: "With regard to the cost of lighting the public lamps with oil, the Borough Treasurer and the Borough Surveyor have gone into the figures, with the result that they are now able to fix the average amount expended for the last three years at £281 7s. 6d. per annum. As against this, the recent tender of the Harwich Gas and Coke Company for lighting, cleaning, and extinguishing such lamps is £502 7s. 6d. Since the last meeting of the Council, however, your Committee have received from the Town and Village Electric Light and Power Company, Limited, the following alternative proposals: (1) To provide for the Corporation a complete installation of electricity, for power as well as for light, and to take payment therefor by instalments extending over forty years; the sum from time to time remaining unpaid bearing interest at 3 per cent. (2) To take over the power of the Corporation, under the Harwich Electric Lighting Order, upon the following terms: (*a*) To provide the installation without any cost to the borough, and to enter into a contract for the supply of electricity for public lighting for the term of fourteen years, at the cost of 4½d. per unit—*i.e.*, the equivalent to 2s. 3d. per 1000 cubic feet of gas; (*b*) to pay the Corporation £300 by an allowance of a 10 per cent. discount off each quarter's account for public lighting until the whole of the £300 is absorbed. Having carefully considered the preceding proposals of the Company, your Committee recommend that the second one be agreed to, and that a contract upon the above terms be entered into." The retiring Mayor (Alderman Durrant, J.P.), in moving the adoption of the report, remarked that the Council had for a long time been considering various proposals for the proper and efficient lighting of the borough. When it was stated that oil had hitherto been used for the public lamps at Harwich, he had no doubt a good many people would have the impression that the borough was about a hundred years behind everywhere else. He did not admit this by any means. But he fully acknowledged that there was room for considerable improvement; and he believed the scheme now laid before the Council would meet with the approval of every resident in the borough. The Mayor-Elect (Mr. W. J. Nalborough) pointed out that the Council were placed in rather a peculiar position with regard to this question. The councillors elected on the 1st of November were all new members, who had not had an opportunity of considering the merits or demerits of the scheme. By supporting the recommendation of the Committee, therefore, they would be adopting a scheme into the details of which they had not gone; while, by rejecting it, they would be ignoring the decision of an old Committee who had given much time and attention to the subject. Under such circumstances, it seemed to him perfectly clear that he could not vote either way, but must maintain a position of strict neutrality. Mr. Whitmore seconded the motion. He said he was altogether opposed to a continuance of the present system, which had been a dead failure; and, if no other scheme had been laid before them, he should have voted for the adoption of gas lighting, notwithstanding the cost. After some discussion, an amendment was brought forward to refer the matter back to the Committee for further consideration. It was, however, rejected by the casting vote of the retiring Mayor. The original resolution was then submitted, in the form that a contract should be made with the Electric Light Company for lighting Harwich, "with such safeguards for the Corporation and the public generally as the Town Clerk may think desirable." Again the voting was equal; and the retiring Mayor—saying that he should most decidedly "stick to his guns"—gave a casting vote for the resolution, which was accordingly carried.

The Corporation of Torquay are still unable to decide whether it is advisable to erect electric lighting works. They obtained their Order so long ago as 1891; and two years ago they had a report from Mr. W. Trentham, M.Inst.M.E., on the means by which the town could be lighted with electricity. At a meeting of the Town Council last Tuesday, the Electric Lighting Committee recommended that a portion of Mr. Trentham's scheme should be carried out, including the establishment of a central generating station under the Bath Saloons, and that application be made to the Local Government Board for power to borrow £18,000 for the execution of the works. Mr. Kerswill, who moved the adoption of the report, dwelt upon the fact that the

time was approaching when the powers possessed by the Corporation would expire; and he said that Mr. Trentham had somewhat modified his estimate of the financial result of the undertaking. At 6d. per unit, the revenue would amount to £3300, or with arc lamps to £3600; while the working expenses would be £1160. Adding interest at 6 per cent., there would be left a net profit of £928, not allowing any revenue from meters, motors, or cooking apparatus. The sanguine estimate of Mr. Trentham that profit would be realized in the first year was challenged by Mr. Harrison, who seconded the adoption of the report; while Mr. Appleton, who followed, contended that the Bath Saloons were a most unsuitable site for a generating station. The Engineer had stated that there would be no nuisance from the boilers; but he said nothing of the nuisance that would arise from the noise of the dynamos. If the station was placed under the Bath Saloons, it would entirely destroy the use of those Assembly Rooms for concerts, meetings, and entertainments; and the value of the adjacent property would be depreciated. The proposed lighting area was very restricted; and he doubted whether they would get the anticipated revenue. The estimate was that £320 would be derived from public lighting. This sum was £95 more than they paid for gas; but it was only 10 per cent. of the anticipated revenue. Had the Committee ground for expecting that, on the line of the compulsory area, they would succeed in getting customers equivalent to 90 per cent. of the revenue? On the introduction of the light, a trader would have to spend about 30s. per lamp, and sacrifice what capital he had already expended in gas-fittings. The schemes of refuse destructor and electric light might be combined. Mr. Appleton concluded by moving, as an amendment, that the report be referred back to the Committee for further consideration and advice. Mr. Shrubb, who seconded the amendment, also advocated the combination of the electricity generating works with a refuse destructor; and he said that at Shoreditch they had a system which enabled them to store the heat from the destructor during the day, and use it at night for driving the dynamos. Other members opposed the scheme as it stood. The Mayor (Alderman Bovey) urged the Council to come to a decision, or at least to give the Electric Light Committee a definite instruction. They had already referred the question back to the Committee three times; and to do this again was practically to shelve it. It was finally decided that the subject should be considered by a Committee of the whole Council.

HUDDERSFIELD CORPORATION GAS AND WATER SUPPLY.

The Working of the Departments—The Illuminating Power of the Gas.

At the Statutory Meeting of the Huddersfield County Borough Council on the 9th inst., the retiring MAYOR (Alderman J. J. Brook) made the customary annual statement upon the work accomplished by the various departments of the Corporation.

His Worship's remarks upon the operations of the gas undertaking, showed that it continued in a steady and prosperous condition. During the year ending Sept. 30, 54,798 tons of coal were carbonized, yielding 558,371,000 cubic feet of gas, which had been enriched to a uniform illuminating power of 18¼ candles. The reconstruction and renewal of the old portions of the works, which were commenced in 1893, had, he said, made rapid progress during the year; and it was anticipated that the whole scheme would be completed by the end of the current financial year. Referring to the public lighting, he remarked that the Gas Committee had, at the request of the District Committees, taken over the control of the burners and regulators in the lamps; and, during the past few months, the whole of the burners in the 2683 street-lamps had been renewed and re-adjusted, whereby the lighting of the public thoroughfares had been much improved and some economy achieved by the regulators preventing waste of gas. It was also satisfactory to note that the results of the working with the improved plant and apparatus, so far as it was completed to the end of March last, was very satisfactory, and fully justified the Council in the expenditure of the large sum of money which the renewal of the old plant had necessitated. Notwithstanding the fact that 3 per cent. more work was done, the expenditure during the whole year was £4391 less than in the corresponding period. The gross profit of the undertaking for the year ending in 1895 amounted to £19,603, the amount being apportioned as follows: Interest on loans, £11,615; redemption fund, £1533; reconstruction of works fund, £6455—total, £19,603. The receipts for the same period were £3135 less, chiefly attributable to a bad market affecting the receipts for the residual products. The Corporation having decided to apply to Parliament for extended powers, the Gas Committee were seeking additional borrowing powers to cover probable capital expenditure during the coming ten years; the chief item being the construction of a large gasholder and tank—the present storage capacity being less than twenty-four hours' maximum supply. In the year 1885, the capital of the undertaking was £222,118; and 36,062 tons of coal were carbonized. In the year ending March, 1895, the capital expenditure was £318,419; and 55,211 tons of coal were carbonized. Thus in ten years the capital had been increased by 43 per cent.; while the amount of work done had increased by 53 per cent., or an average of rather more than 5 per cent. per annum on the consumption of gas. Basing an estimate on the past decade, ten years hence—viz., in 1905—there would be a capital of £455,339, and 84,472 tons of coal carbonized; or an increase of £136,920 on the capital account, and 29,261 tons additional coal used. A sum of £100,000 was being applied for to meet the probable requirements for the term mentioned; the balance of capital now remaining unspent—£29,054—being sufficient to make up the difference between the anticipated expenditure and the amount to be applied for.

Turning to the Water Department, the Mayor stated that all the storage and service reservoirs had been kept in good order. The quantity of water in store in Blackmoorfoot reservoir was 304 million gallons, as compared with 542 million gallons at the corresponding time last year. The renewal of mains during the twelve months had been 1084 yards, as compared with 1791 yards last year. The extension of mains had been 2343 yards, as against 3794 yards last year. The total length of water-mains was about 236 miles. The number of gallons of water supplied through meter in the year was: Inside the borough, 414,919,000 gallons; outside the borough, 56,680,000 gallons—total, 471,599,000 gallons, as compared with 418,461,000 gallons last year, thus showing an increase for trade purposes of 53,138,000 gallons. The population supplied totalled to 146,330, as compared with 145,705 last year. The number of meters fixed was 605, as compared with 573. The net income for water for the year ending March 31 was £46,812; and the profit on the department was £890.

Later in the proceedings, the Gas Committee presented their minutes, which showed that the average illuminating power of the gas during September had been reported by the Manager (Mr. W. R. Herring) to be equal to 18·15 candles. Some conversation ensued as to the quality of the gas, in replying to which Alderman Stocks said the Gas Committee were doing their utmost to give the town the best gas they could make. They were about to apply to Parliament for power to raise £100,000—not for any hobby, but to extend the works to enable them to meet the demands, and to supply gas of high quality. He believed they had in their Engineer a very competent man; and he had no objection to any tests of the gas that might be made in the presence of members of the Council. The minutes were confirmed.

SOUTHAMPTON GASLIGHT COMPANY.

The Half-Yearly Meeting of this Company was held on the 6th inst.—Mr. R. C. HANKINSON presiding.

The Directors' report for the six months ending June 30 stated that the profit and loss account showed that the amount available for dividend was £11,250. From this the Directors recommended the payment of maximum dividends, amounting to £8312, for the half year on all classes of shares, leaving a balance of £2938 to be carried forward. During the six months there had been an increase of 10,376,000 cubic feet of gas sold, as compared with the June half of 1894.

The CHAIRMAN, in moving the adoption of the report, stated that the quantity of coal carbonized during the half year amounted to 17,394 tons, as compared with 16,113 tons in the corresponding half of 1894; there being thus an increase of 1281 tons. The amount of gas sold, including the lighting of the public streets, was 178,148,000 cubic feet; and for the corresponding period of last year it was 167,772,000 cubic feet—the increase being 10,376,000 feet. This great advance was no doubt accounted for partly by the severe winter, which occasioned the Manager (Mr. S. W. Durkin) and officials a good deal of anxiety. It would be observed by the accounts that the renewals and repairs had come abnormally heavy during the half year. The proprietors must remember that the Directors were not allowed to raise a reserve fund for the purpose of writing off anything for depreciation of the works. It was, however, their bounden duty to keep them in the utmost state of efficiency; and this they had endeavoured to do. The receipts for residuals showed a small increase during the half year.

Colonel GRIMSTON seconded the motion.

The CHAIRMAN, in answer to a question, said it was true they had not earned the dividend in the half year by some £700 or £800; but there were several reasons for this. The first was the cost of the renewals, and, next, that a good deal of the new capital had been expended in new works which had not yet become remunerative; but it was pleasing to know that, if they took the figures for the whole year, they had not only earned the dividend, but a little over. Further, they had lately reduced the price of gas; and yet they carried £3000 of undivided profits forward. It was probable they would very soon require more capital.

The motion having been carried,

Resolutions declaring the maximum dividends and thanking the Directors and officials were passed.

Extension of the Sunderland and South Shields Water-Works.—The Sunderland and South Shields Water Company are about to construct a main from Seaton Bank Top to the Jarrow district. A reservoir capable of holding about 3 million gallons of water will be erected at West Boldon; and the total length of the new pipes proposed to be laid down is 13 miles.

Newport Water Supply.—Some time ago, the Newport Corporation sought the advice of Mr. C. Hawksley, M.Inst.C.E., Mr. G. H. Hill, M.Inst.C.E., and Mr. Gitteridge, in regard to their Wentwood water scheme. These gentlemen have sent in their report, which is understood to be of an unfavourable character; and it is expected that this may lead to a modification or probable abandonment of the undertaking. They have advised the abandonment of the works, on the ground that, if they were completed, the reservoir would, in their opinion, not hold water. They also think it was impossible to ascertain that the geological formation was unsuitable. The probable outlay which has been incurred up to the present time is between £30,000 and £35,000. The Water Committee of the Corporation met last Wednesday to consider the report; and, after spending two hours in discussing the situation, the resolution was come to to lay the matter before the whole Council in Committee, and to take their decision upon it.

Oriental Gas Company, Limited.—In the report to be submitted at the forthcoming meeting of this Company, the Directors state that the business in the year ending June 30 showed an increase as compared with the preceding twelve months. A greater quantity of gas was made and sold, and the revenue from all sources was higher by nearly £3000. On the other hand, the expenditure was but very slightly and disproportionately augmented. The Company's operations, therefore, so far as they are within the control of the Directors, present a satisfactory result. Unfortunately, however, the adverse rates of exchange have, to a considerable extent, neutralized this result, and have very largely diminished the net profits. Since the close of the financial year, however, the rate has slightly recovered. The balance of the general revenue account (after payment of the interim dividend of 3¼ per cent. in June last, and carrying £1500 to the reserve account) is £31,951, out of which the Directors recommend the payment of a dividend of 4¼ per cent., free of income-tax; making a total dividend of 8 per cent. for the year, and leaving a balance of £18,451.

METROPOLIS WATER SUPPLY.

The Proposed Alteration of the Metropolitan Water Supply Regulations.

(*Continued from p.* 991.)

At the close of the case for the County Council, evidence on behalf of the Water Companies was immediately taken.

Mr. *E. M. Eaton*, Assoc.M.Inst.C.E., said he had been for 26 years Engineer of the Sheffield Water-Works. Until 1887 the works were in the hands of a Company; but in that year the Corporation took them over. Under the bye-laws, the maximum flush allowed was two gallons, which was found to be eminently satisfactory. He did not know of a single case where a closet-trap or soil-pipe had been stopped merely by excrementitious matter or paper. There were only about 7000 closets in Sheffield, which was not a closeted town. He attached very great importance to the down pipe being 1¼ inches in diameter; and where the cistern was only a little above the closet, he should make the pipe a trifle larger. The cistern should be about 4½ feet above the closet. He attributed the whole success of the system in Sheffield to the insistence upon the regulation relating to the wide flushing-rim. [Witness produced two models. One, called the "Oxford," had merely a deflector-rim, which did not flush at all. Water discharged into it was distributed by the spreader at the back; and the whole operation was performed by the spreader—the rim merely acting to prevent the water flowing on the seat. In the other one, called the "Cambridge," the rim was rounded off, and curved in to the basin on the inside, so that the water was equally distributed, and everything was carried away—all the sides being washed.] There was no basin better than the old-fashioned short hopper cottage basin—the cheapest, and in many respects the simplest, on the market. It had been in use in Sheffield for 25 years, and was as effective as anything yet introduced. He objected to the drain being considered at all in connection with the flush. The function of the closet was to cleanse the basin, clear out the trap, and remove everything from the soil-pipe into the drain. It was more important to regulate the type of basin than the flush. The proposed alteration in the quantity of the flush would entail a greatly increased charge upon the Water Companies.

Cross-examined: Before a closet could be put up in Sheffield, it had to be passed by the Corporation officials; and unless it had the rim of which he had spoken, it was not fixed; or, if fixed, water was not laid on. He disagreed with that part of the model regulations of the Local Government Board which related to the pan having a large water surface to receive the excreta. He did not see any advantage in a larger flush than two gallons; and with a proper flush, no paper or light material was left. A model of the closet used at the Yabsley Street Buildings was produced; and witness stated that he thought it had a slotted rim, which was different from the kind he favoured.

Re-examined: He considered there would be imperfection in the flush from a pan with a slotted rim.

Mr. *E. Collins*, M.Inst.C.E., Engineer to the New River Company, said the Company supplied about 160,000 houses. Previously to 1872, the amount of water for each service-box varied from a gallon and a half to two gallons; but it was not fixed. In 1872, it was settled at two gallons. The syphon flushing-box was not then known or generally in use; the one that was common being the double-valve box. Continuing, witness said the two gallons were not always discharged from the waste-preventers; and there were some thousands in London that did not contain more than a gallon and a quarter. Some of these did not discharge even as much as that. With a proper pan, a flushing-rim, the flushing-box at proper height, and a down-pipe of 1¼ inches, two gallons were a sufficient flush. In many old closets still in use, the inlets to the basin, though the down pipe was of proper size, were not as large as the pipe. With a 1¼-inch down pipe, the height of the flush should be between 4 ft. 6 in. and 5 feet. The delivery, to which he attached much importance, should be given in four seconds. The two gallons were sufficient to clear the pan and the trap; but the matter of clearing the drain-pipe, he considered, did not come under the jurisdiction of the Water Companies. The flush depended somewhat on the one that followed it. In a drain at a gradient of 1 in 60, two gallons would carry an ordinary amount of soil and paper about 25 feet. The general question of the flushing of closets had been affected recently by the introduction of "combination" closets, which were causing much more water to be used. He did not see how the excreta remaining in the drain-pipe would affect health, because any gas arising therefrom would pass through the air-pipe, and thus not enter the house. He attached much importance to the effect of bath water upon the drains. The Company employed some sixty inspectors to detect waste; and a year ago they were instructed to note all cases of stoppage in drains where the closets were properly supplied with water. He had had complaints from the inspectors of a total absence of water in the winter, but not one where the closet complied with the regulations, and had a two-gallon waste-preventer. Where stoppages had occurred, they were due to the introduction of extraneous matter. In passing, witness alluded to a portion of the evidence of Mr. Doll, one of the witnesses on the other side, who had said that the Company in one case had consented to his having a three-gallon waste-preventer. He said that the Company did not give their consent, but that Mr. Doll had put up the appliance behind their backs. Continuing, he stated that he demonstrated to his own satisfaction to the Sanitary Institute that the two-gallon flush was sufficient to clear the pan and trap. The Committee, however, then shifted their ground, and said he could not clear the house drain. They conducted experiments of their own; but he did not think they were important, as the conditions were not fair. Witness went on to give figures showing that there were, as he estimated, 320,000 water-closets in the district supplied by the Company. He had found, from a form which was filled up by the occupants of 41 houses, that the average number of times a closet was used was ten daily. Taking off 25 per cent., so as to be on the right side, there would be an increase in the flushing of those closets, which would make a difference of 2,400,000 gallons a day over the district of the New River Company, and of 12,000,000 gallons over the whole of the Metropolitan district. He thought the Companies ought to be empowered to specify what fittings should be used, as this would make a great difference in their effectiveness. The New River Company had fitted up, for experimental purposes, apparatus which represented as nearly as possible what would be the position in a dwelling-house; and the Inspector could see the apparatus if he wished to do so.

Cross-examined: It very often occurred with present fittings that the two-gallon flush gave unsatisfactory results. There was no obligation on the Companies to insist that a flushing-box should contain two gallons. Very often he stamped boxes containing less. There were cases in which the down pipes were smaller than 1¼ inches in diameter, but few had occurred recently. The flush should clear the pan, the trap, and the soil-pipe—the pipe running from the closet to the house drain. Both water and rain would materially assist in doing this. There were instances where the New River Company allowed the three-gallon cistern to be used; but it was where the water was supplied by meter. In many cases, people, merely from habit, and not because of necessity, pulled the handle before as well as after using a closet, where there was a two-gallon flush. There would be no saving in having a three-gallon flush, as people would still act in the same way. There were very few automatic flushing-tanks. He condemned them strongly as being wasteful; and where the supply was not by meter, the Company refused to allow them to be used. He thought the best pan they had was capable of improvement. He should like, however, to see the short hopper pan employed in cottages and model dwellings; and he was not aware that this would be opposed to the model regulations of the Local Government Board. Apart from the experiments conducted at the New River Head for the Sanitary Institute, there was another set made with five or six artificial closets, for the special purpose of showing that a two-gallon flush would clear the pan. Asked to suggest a remedy in cases where this flush was insufficient, witness said he would alter the pan.

Mr. *W. B. Bryan*, M.Inst.C.E., the Engineer to the East London Water Company, said the Company's district contained a large number of small houses, the flushing-cisterns in which, in very many instances, he had examined. He found that, with fittings and apparatus proper in every respect, the two-gallon flush was perfectly effectual; and he had made experiments which proved this. If a three-gallon flush should become general, it would represent an increased consumption of from four to six gallons of water per head per day. This he thought would be caused chiefly by the closets being used as urinals. The remedy for cases where the two-gallon flush was insufficient was the provision of proper fittings.

Cross-examined: The two-gallon flush was defective only where the fittings were defective. The three-gallon flush was totally unnecessary. He had no statistics to show, as he believed, that the consumption of water had increased since the introduction of combination closets.

Re-examined: In the Beachcroft and Yabsley Street Buildings, the cisterns had a down pipe of 1¼ inches in diameter. There could be no fair comparison between the closets at the two places, as in one case the flush descended far better than it did in the other; and the construction of the pan and other conditions were not equal.

On the inquiry being resumed on Tuesday, the 5th inst.,

Mr. *Collins* was re-examined by Mr. PEMBER. He said the two-gallon flushing-cisterns only failed when the fittings were in an improper condition; and three, four, or even six gallon cisterns would also fail under these conditions. The effect of the proposal of the County Council would most decidedly be retrospective. If the Council made an order that nothing but three-gallon cisterns should be used, it would necessitate the alteration of the whole apparatus for flushing purposes in dwelling-houses, and would cause an immense outlay of money. At the very lowest estimate, the expense of altering the water-closets could not, under the most favourable circumstances, be less than £3 apiece. This meant £960,000 in the New River Company's district alone. In the whole Metropolitan area, it would entail an outlay of £4,800,000; and taking off 50 per cent., it would mean two millions of money.

Mr. *A. E. Farrant*, the Deputy-Chairman of the Artizans' and Labourers' Dwellings Company, the Chairman of the Middle Class Dwellings' Society, and the Deputy-Chairman and Managing-Director of the Rowton House Company, said that the Artizans' and Labourers' Dwellings Company owned and kept in repair 5048 cottages and shops; the number of their tenants being upwards of 7000, irrespective of the lodgers the tenants took. They had 7420 water-closets, in each of which the waste-preventer cistern was uniformly of two gallons capacity; and their experience was that these cisterns were perfectly satisfactory. The closet they used almost invariably was a short hopper one, which was an improvement on the old form, which was somewhat in the shape of a funnel. They had found a two-gallon flush amply sufficient to keep the closet clean, and to answer all purposes. They took special care in fitting the pans; this being done by their own workmen. At the Yabsley Dwellings, in Poplar, which were spoken about by Mr. Bury as having given a certain amount of trouble by getting stopped up, it struck him that the difficulty was owing to the new tenants not being accustomed to the conveniences. The closets might be used repeatedly without being flushed at all. His Company had flats at Buckingham Palace Mansions, at Ridgmount Gardens, and at Gordon Mansions. In some of these, the closets had three-gallon cisterns; but in those cases the basins and traps were the same as those in use with two-gallon cisterns. There had never been a case of stoppage with a two-gallon flush, except where a house flannel or a scrubbing-brush had accidentally found its way into the pan. In regard to the Rowton House property, they had there accommodation for 184 lodgers. There were 40 water-closets in the house, 16 of which were available only at night. There was approximately one closet to every 20 men; so that these conveniences were more used than those in private houses, or even in hotels. The flushing-cisterns were of two-gallon capacity. Though they were rather low down, and therefore not under the most favourable conditions, in three years there had been no complaint as to their efficiency; and there had never been any difficulty as to the drains. The pans were always perfectly clean, and as satisfactory as they could be. The Company kept the place in repair.

In cross-examination by Mr. FREEMAN, witness said that the water for Rowton House was paid for by meter. It was true that, in the case of some of their property, the Company had used cisterns with a three-gallon flush; but before the houses were completed, the style of closet was altered. The pans were changed, but the cisterns were

allowed to remain. He had never heard any objection raised by the Water Company.

Mr. *J. W. Gray*, M.Inst.C.E., said he had been for 29 years Engineer of the Birmingham Water-Works, having been connected with the undertaking when it was in the hands of a Company, till 1876, and then continuing in the service of the Corporation when they took it over. Though he had discontinued active employment in connection with the Birmingham Corporation, he was still their Consulting Engineer. He was a member of the Guild of Plumbers of Birmingham. In the course of his professional experience, he had made himself familiar with most modern sanitary appliances. The Birmingham Corporation had the following bye-law :—

A person who shall fix or fit on any premises any water-closet or urinal apparatus that may be intended to be used for receiving or delivering the water of the Corporation shall comply with the following regulations, that is to say: (1) Every water-closet cistern other than a double-valve cistern shall have an efficient waste-preventing apparatus so constructed as not to be capable of discharging more than two gallons of water at each flush; and every water-closet cistern being a double-valve cistern shall have an efficient waste-preventing apparatus so constructed as not to be capable of discharging more than *three* gallons of water at each flush. This regulation shall apply only to cisterns of every water-closet used in respect of a single or separate house or building. (2) Every urinal cistern, other than public urinal cistern or cisterns having attached to them a self-closing apparatus, shall have an efficient waste-preventing apparatus, so constructed as to be capable of discharging not more than one gallon of water at each flush. (3) No pipe by which water is supplied to any water-closet shall communicate with any part of such water-closet, or with any apparatus connected therewith, except the service cistern thereof.

In sending this bye-law for the purposes of the present inquiry, the Birmingham authorities had stated that a two-gallon cistern was invariably used in Birmingham; and that, when it was properly fixed and had a suitable basement, it was found to be perfectly satisfactory. He (witness) thoroughly endorsed this statement. He attached the greatest importance to the closet being properly constructed. He was acquainted with the short hopper closet referred to by the last witness; and he considered it a very good one. He had never heard any complaints about the flushing power of two-gallon cisterns. Complaint was made as to the length of time they took to fill; but this would be accentuated in the case of a three-gallon cistern, as the overflow was always slow.

In cross-examination, witness said that all the regulations, both as to waste of water and sanitation, were in the hands of the Corporation. The regulations bearing upon the water supply in Birmingham were made in the time of the Water Company; but now, under the Corporation, they were bye-laws. He agreed with the last witness that a three-gallon flush was no more cleansing than a two-gallon one. If a two-gallon flush was sufficient, a three-gallon flush was waste.

Mr. *J. W. Restler*, M.Inst.C.E., the Chief Engineer of the Southwark and Vauxhall Water Company, stated that his Company supplied 120,000 houses, or, roughly speaking, 900,000 persons, with water. His attention had frequently been called to Regulation No. 21 under the London County Council; and he had found the wording of it, since the intermittent service had been changed for a constant supply, very difficult to understand. In cases where there had been a defect in the flush with a two-gallon cistern, it was attributable to the insufficient size of the down pipe, or to a defect in the pan or in the cistern itself. Taking the poorer portion of the district, 50 per cent. of the flushing-pipes were less than 1¼ inches in diameter; but, under the present regulations, the Company were powerless, in the case of the existing fittings, to require that the pipes should be made of lead, and be 1¼ inches in diameter. An amendment of the regulation prescribing the kind of pipe would be useful. If the Water Companies had the power possessed by municipal bodies, it would be of advantage to them, and of benefit to the localities. Less than one-third of the local authorities in his district, after receiving the circular-letter of the London County Council, had assented to the proposal contained in it that the size of the cisterns should be enlarged. There had been no demand for an increased flush, and no public meeting or agitation for it, until the County Council had taken action in the matter. With regard to the flushing power of a cistern, so long as it removed everything from the closet-pan and the trap, it did all that was expected of it; and, in his opinion, a two-gallon waste-preventer, with a suitable down pipe and closet-pan, was all that was needed. Mr. Binnie had suggested that water would be saved by a three-gallon flush, for the reason that a two-gallon flush was insufficient at one pull of the chain, and that a second pull would have to be made. He (witness) did not agree with that. A two-gallon flush was ample; and therefore, when three gallons of water were discharged, one gallon was wasted. If a three-gallon flush were insisted upon, it would mean an increased supply from his Company of about 2 million gallons of water per day.

In cross-examination, witness said his estimate of the increased supply was founded on the assumption that each closet would be used four times a day by each person living in any house.

Mr. *E. J. White*, Assoc.M.Inst.C.E., Director of the Lambeth Brass and Iron Company, Limited, and a specialist in the manufacture of sanitary appliances, gave evidence in support of a two-gallon flush, the efficiency of which, he stated, depended on the construction of the basin of the closet, the down pipe, and the cistern. The short hopper closet which had been spoken of was the best form of pan with which he was acquainted. He had always found a two-gallon flush efficient and sufficient.

Mr. *M. W. Hervey*, M.Inst.C.E., the Engineer of the West Middlesex Water Company, considered a two-gallon flush sufficient for all requirements.

At this point, the Inspector was conducted over the building in which the inquiry was taking place, in order to examine the washout and non-washout closets there in use.

Mr. *Pullen*, a builder and contractor, having blocks of houses in Walworth, containing 500 water-closets, stated that the short hopper closets were the best for all practical purposes; and that these could be efficiently cleared and cleansed by a two-gallon flush, provided those who used them did not put into them house flannels, hearthstones, scrubbing-brushes, halfpenny bundles of wood, and so forth.

In cross-examination, witness said that with a two-gallon flush he had never known a closet-pan to be dirty.

Mr. *T. F. Parkes*, Assoc.M.Inst.C.E., the Engineer to the Lambeth Water Company, stated that, with proper appliances, according to his experience, a two-gallon flush was ample. If three-gallon cisterns were substituted for those containing two gallons, it would cause a great increase in the water supply in the Lambeth district. The population supplied by his Company within the Metropolitan area was 497,000; and the proposed regulation would necessitate, to supply this, an extra 2 million gallons of water a day. The cost of fitting up the necessary appliances to give such a supply would be £250,000, or about £4 10s. a house for 70,000 houses.

Major *L. H. Isaacs*, ex-M.P. for Walworth, and the Surveyor to the Holborn District Board of Works, also gave evidence in support of a two-gallon flush, which he stated would be amply sufficient for all practical purposes, if the other appliances were of a proper kind.

Mr. *J. Phillips*, who, in 1846, was the Chief Surveyor to the Westminster Court of Sewers, said that, after fifty years' experience, he was prepared to say that a two-gallon flush was ample for all domestic purposes.

Mr. *A. A. Gill*, Assoc.M.Inst.C.E., the Engineer to the Chelsea Water Company, said a two-gallon flush was amply sufficient under ordinary conditions. If a three-gallon flush were made general, it would increase his Company's supply by 12 per cent., or 1½ million gallons.

Cross-examined: The whole of his evidence was founded on the fact that no complaints had reached him of the insufficiency of the two-gallon flush. The experiments made by the New River Company had confirmed his view.

Mr. *E. K. Burstal*, M.Inst.C.E., of the firm of Messrs. Stevenson and Burstal, stated that he had been called upon to advise many water authorities in the establishment of supplies, and had never recommended the use of other than two-gallon cisterns for flushing purposes. These were almost universally employed in the provinces; and no complaint of them had reached him from any sanitary authority. If a two-gallon cistern did not flush properly, the fault was with the closet or the fixtures, and not with the cistern.

Cross-examined: There was an exhaustive inquiry into this question some years ago at Sheffield. Later, in 1888, it had been investigated at Portsmouth; and a provision had been made in the award for the use of two-gallon cisterns. Until this inquiry, he had not heard that engineers were divided in opinion in regard to the two-gallon flush. He had never thought it would be seriously contended, save by gentlemen who had invented new appliances, that a two-gallon flush was insufficient.

The inquiry was again adjourned.

The inquiry was continued on the 6th inst., when

Mr. *A. Dickson*, the Secretary of the Kent Water Company, said the closets in his district were not always of a satisfactory type. Where the fittings were efficient, the two-gallon flush was adequate, as it would cleanse the pan, carry the contents through the trap and soil-pipe, and usually along the drain. Witness did not see the experiments made by the Sanitary Institute; but he saw the arrangements under which they were carried out. The mode of testing the effect of a flush was not fair, because it did not correctly represent the conditions existing in the houses in his district. No allowance was made for any aid that might be obtained from sinks, baths, &c. If the failures with a single flush of two gallons amounted to only 3 per cent., he should say the flush was satisfactory. A Committee of the Sanitary Institute, consisting of Mr. Rogers Field, Dr. Confield, Mr. Ernest Turner, Mr. F. W. Cutler, and Mr. White Wallis, attended some experiments carried out at the works of the Kent Water Company, at which a "Norwich" double-chamber flushing-cistern was used. It had been designed to hold two-and-a-half gallons; but its capacity was reduced to two gallons. The pan was of the short hopper type—a patent of Messrs. Guest and Chrimes—and had an open, not slotted, rim all round. Apples were placed in the pan, and a number of experiments with the two-gallon flush, under various conditions suggested by the Committee, were made, and acknowledged to be satisfactory. Other experiments were carried out with the old hopper wash round pan, to show the difficulties and restrictions in connection with them. The Committee were satisfied that, with proper fittings, two gallons would give an adequate flush.

Cross-examined: If the chain of a "Norwich" flushing-cistern were not held down till the end of the flush, the flush would be shortened. In practice, the warning-pipes were not generally such as to prevent the full two gallons flowing. In closets put up in recent years, there was generally a 1¼-inch down pipe, with an inlet of similar capacity to the pan. He attached great importance to the rim of a pan being open all the way round, and not slotted. He knew, however, that the model bye-laws of the Local Government Board referred to pans in which water should stand for excreta to fall into.

Mr. *E. Yates*, a builder, of Walworth, said he was connected with property in which there were between 3500 and 4000 water-closets. The two-gallon flush was universal among them, and was sufficient for practical purposes. He had lately used the "Improved Artizan" type of short hopper pan; and he was careful to have a 1¼-inch pipe, with an inlet of the same size.

Mr. *R. W. P. Birch*, M.Inst.C.E., a member of the Council and of the Examining Board of the Sanitary Institute, as well as one of the Exhibition Judges of that body, stated that the report of the Institute in respect to the experiments was written and adopted in great haste for the convenience of the County Council; and he protested against it at the time. He had the figures which represented the results of the experiments; but the conclusions he drew from them were different from those of the Committee. It appeared from the report that the two-gallon flushes were discharged in five seconds each; whereas the three-gallon flushes occupied seven seconds. This made it rather difficult to say how far the results were due to the larger quantity of water, and how far to the increased velocity of the discharge. The experiments went to show also that a long drain should be 4 inches in diameter at the upper, and six inches at the lower part. This would improve the action of a two-gallon flush. By increasing the fall of a 50 feet house drain from 1 ft. 3 in. to 1 ft. 8 in., its efficiency might

be increased by about 30 per cent. Witness thought it was impossible to provide that the excremental matter should always fall so as to drop into water in pans. With good and proper fittings, he did not think the increased flush was required.

Dr. *H. W. Roberts*, the Medical Officer of Health for Deptford, stated that, with a properly constituted closet, his experience was that two gallons constituted a sufficient flush. He had five inspectors under him; and they all agreed as to the adequacy of that flush.

Mr. *H. S. Barham*, a builder, of Blackheath, said he had erected forty houses on one estate at Blackheath, putting one closet in some, and two closets in others. During the last three years, he had used the short hopper pan, and had taken care that the other requirements were fulfilled. The two-gallon flush was always sufficient.

Mr. *W. Lewis*, for 32 years caretaker of the tenements of the Improved Industrial Dwellings Company in Crossfield Lane, Deptford, stated that the closets, 155 in number, were in his charge. They consisted of stoneware short hopper pans, with a single-valve flushing-cistern of two gallons capacity connected with the pan by a 1¼-inch down pipe. The two-gallon flush was always sufficient.

Mr. *J. Ward*, an Inspector of the Kent Water Company, said he visited, on the 1st inst., the East Greenwich Cottages, which were artizans' tenement dwellings of the London County Council. The water-closet basins there were of the short hopper pattern; and the flushing arrangement was Boulding's syphon—the discharge being two gallons. He selected twenty tenements at hazard, and interviewed the occupants; but in no case did he receive any complaint of stoppage.

Mr. FREEMAN said he had a list of stoppages which had occurred in blocks of tenements visited by Mr. Ward.

Witness denied having been to the particular tenements where the stoppages had happened, or that he had knowledge of them.

Mr. *J. Moore*, the Secretary to the Improved Industrial Dwellings Company, also spoke of the efficiency of the two-gallon flush in the tenements of the Company.

Cross-examined: The Company's buildings were from five to seven storeys high; and the closets, being under one another, were in an exceptionally favourable position as regarded flushing.

Professor *W. R. Smith*, the holder of a number of public positions, and the President of the British Institute of Public Health, stated that, with proper fittings, two gallons of water were sufficient to clear a closet pan, trap, and soil-pipe. Witness corrected a statement made by Dr. Parkes, one of the previous witnesses, by saying he (Dr. Parkes) was asked by the Council of the Metropolitan Branch of the Society of Medical Officers of Health, not by the branch itself, to attend and give evidence.

Mr. *F. Gollan*, the Chief Inspector of the Kent Water Company, also bore testimony to the efficiency of the two-gallon flush. He said it worked well in Sheffield; its success being due partly to the control which the Corporation had over the fittings used. London fittings were very inferior to those in use in Sheffield.

On the resumption of the inquiry on the following day,

Sir *F. Bramwell*, F.R.S., the first witness, stated that, in his judgment, the two-gallon flush, when good, and properly used, was sufficient. The introduction of the lift-up lid closet had caused a very large amount of male urination to be made down such closets; and where formerly a gallon flush was deemed sufficient to carry it away, two gallons were now used, and were ample for the purpose. Therefore, if the increased flush were adopted, only waste would follow; and the amount of the waste would be enormous. Between 1881 and 1893, the increase in the domestic consumption of water in the districts supplied by the Metropolitan Companies amounted to two gallons a head per day. With five people to a house, this meant an increase of 10 gallons a day per house, or in the aggregate of 10 million gallons daily, taking the population at 5 millions. The augmented flush would add a very serious responsibility to the purveyors of water, and involve an additional burden on the sewers. In the less costly class of houses, there was usually a portable bath, which was generally emptied into the closet, and afforded material assistance in washing out pan, trap, soil-pipe, and drain-pipe. As this water entered the basin *en bloc*, it was very effectual. Witness thought the most effectual flush of all, if practicable, would be the throwing of a pail of water down the closet. Before the passing of the regulations of 1872, there had been much discussion, notably in the Sheffield case, as to the quantity of water necessary for a flush. Witness went on to express approval of the proposition that slop-sinks—those down which excrement was passed—should be brought under the regulations relating to the flushing of closets; and he also agreed with Mr. Pember that the other regulation, to prevent cisterns communicating directly with a water-closet cistern from supplying water for domestic purposes or for the use of animals, was a proper one. It was, however, already attained, practically, by existing regulations. In regard to the remaining proposal—that, in all cases where premises had a constant water service, one or more taps should be connected with the rising main for drinking purposes—he should have thought the consumer was at liberty to do this at present. He did not think, however, that it appertained to the duty of the Water Companies. London being one of the most closeted towns in England, the matter of the increased flush was more important than elsewhere.

Cross-examined: If it were shown that, with the best appliances properly used and kept in good order, the two-gallon flush was insufficient, he should favour the increase. He did not know that the two-gallon flush did not keep the closets clean. There had been a considerable increase in the consumption of water since the introduction of the combination closets; and he thought he might connect the two. Much of this increase was due to baths, the use of which had largely increased of late. He knew that, since 1872, Bradford and Edinburgh had made regulations allowing a three-gallon flush. In his calculation as to the extent to which the larger flush would increase the consumption of water, he had considered that each person would use the closet for both purposes four or five times daily.

Re-examined: The syphon and combination closet together were fatal to economy in water supply.

Mr. *Berry*, recalled, and examined by Mr. PEMBER, said that, in some of the County Council's buildings with which he was connected, there were two closets, each of which was connected with a common soil-pipe. There was the bend of the trap itself; and he thought two others besides. The stoppages had occurred in the traps, and not in the soil-pipes.

Mr. PEMBER said he was informed that the stoppages had taken place in the soil-pipes.

Witness, in reply to Mr. FREEMAN, said stoppages had occurred in the soil-pipes; but he had not accounted for them in the lists he had previously given. The stoppages in the traps might lead to stoppages in the branch soil-pipe.

Mr. *Walker*, the Superintendent of the County Council's buildings at East Greenwich, where there are 78 closets used by about 400 persons, said that between November, 1894, and November, 1895, there were 21 stoppages, not counting those due to frost. Manholes were placed near the closets, and two of these had been stopped. Residents at first were somewhat careless in the matter of flushing; but they behaved better after awhile.

Cross-examined: In some cases, four flushes had occurred in connection with one block of tenements, but on different floors.

Mr. SATCHWELL, the Superintendent of the County Council's buildings at Hughes Fields, Deptford, stated that he had had to unstop closets there, in addition to inspection chambers on nine or ten occasions, in the past six months. These cases did not include stoppages caused by extraneous matter.

Cross-examined: The residents were very poor, and often did not flush the closets.

Mr. PEMBER then addressed the Inspector on behalf of the Water Companies. In regard to the proposal relating to the slop-sinks, the Companies did not oppose it, as these sinks were really water-closets. As to the last two proposals, which dealt with preventing cisterns connected directly with a closet from being used for domestic purposes, and with the placing of taps on the rising mains, he had come to the conclusion that they were totally unconnected with the Companies, and that, if added to the regulations, they would form merely the thin end of the wedge for introducing more foreign and irrelevant matters. In regard to the alteration of the size of the flush, over which the real fight was taking place, he thought sufficient had transpired to make it clear that the Companies were being called upon to make good the shortcomings either of the sanitary engineer, the plumber, the builder, or the architect, who were responsible for the equipment and maintenance of the sanitary appliances of a house. It was altogether a perversion of the Acts of 1852 and 1871, which provided against waste and the undue consumption of water—a commodity which was far too precious to be lightly wasted. If this demand were right for one town, it was right for another. It would follow, therefore, that, with the exception of Bradford and Edinburgh, and one or two other instances which had been quoted, there ought to be a revision of the regulations of the towns of the kingdom; and then the water consumption of the country would be seriously added to. There were, to his mind, three aspects of the case—namely, the waste of water, the waste of money in providing an unnecessary quantity of it (and this would be very considerable), and the question of the injustice to the purveyors. He contended that the change should only be made after all the local authorities of the kingdom had contributed evidence. Nowhere was there such scandalous waste of water in large quantities as in many districts of London; and nowhere were there such bad fittings, both as regarded construction and maintenance. The learned Counsel asserted that, in connection with some of the more important requirements—the size of the cisterns, dimensions of the down pipe, inlet to the pan, height of the flushing-cistern, or laying the drains—neglect and omission had occurred. There had been no supervision of these matters. Until such supervision was exercised, they were practically encouraging faulty construction and inefficient maintenance of the fittings, and saying they would overcome these defects by giving a superabundant supply. All he had said was based on the hypothesis that the two-gallon flush was efficient; because if it were not, there would have been an outcry all over the country years ago. As regarded the evidence for the case of the County Council, he said he might summarize it in the statement that, considering the great extent of the imperfection of the fittings, two gallons were running it rather fine; and then their chief desire seemed to be to clear the house drain, which was not the Water Companies' business at all. After reviewing the evidence at length, the learned Counsel concluded by asserting that the origin of the demand was sudden; that it was lightly and recklessly taken up; and that it was by no means universal.

The inquiry was resumed and concluded on the 8th inst.

The INSPECTOR, in opening the proceedings, said it had been stated that the short hopper closet of the "*e*" Doulton type was in contravention of the model bye-laws of the Local Government Board. Which bye-law did it contravene?

Mr. FREEMAN: Bye-law 69, and particularly paragraph 3.

The INSPECTOR pointed out that the style of closet he had alluded to did not seem to have been invented at the time the model bye-laws were written. There was, however, a drawing attached to bye-law 69 which appeared identical with that style of closet, except that it was not quite as straight at the back.

Mr. RICKARDS said he understood that the Local Government Board did not object to this closet.

The INSPECTOR did not think they did.

Mr. RICKARDS said he was much obliged to the Inspector for mentioning the matter, because it was well to know that the closet was not disapproved of by the Local Government Board. He took it, too, that the Inspector's remark applied to short hopper closets generally.

The INSPECTOR expressed assent.

Mr. FREEMAN then proceeded to address the Inspector in support of the case for the London County Council. He asserted that, if he established that the increased flush was a sanitary requirement, it should be made the subject of a regulation, even if it entailed more water being used, and some reduction of the dividends of the Water Companies. If places like Bradford, Edinburgh, Croydon, Gloucester, and other towns, had felt it necessary to make regulations causing the use of a greater flush than prevailed in London, surely such regulations would be good for London. In these towns, he pointed out, the Corporations, who were the sanitary authorities, also owned the water supply;

and consequently they had no dividends to consider. After dealing very briefly with the proposed alterations or amendments in the regulations, apart from the matter of the increased flush, Counsel proceeded to say that both sides were agreed as to the necessity of the flush clearing the pan, trap, and soil-pipe, by which was meant the drain communicating with the house drain. The Companies, however, contended that they were relieved by the Act of 1852 from any responsibility regarding the drains or sewers. He admitted that there was no obligation upon them, under the head of domestic supply, to turn on water for flushing drains and sewers; but he did not think it had been intended, or that the Act could cover the proposition, that so long as the contents of the pan were sent through the soil-pipe, the Companies had nothing further to do. He disagreed very much with this view, and asserted, moreover, that the two-gallon flush often did not clear the pan, trap, and soil-pipe—things which the Companies admitted they were bound to do. Dealing with the contention that the remedy, in cases where the two-gallon flush was inefficient, lay in the use of proper fittings, he stated that regulations to effect this object had already been made by the County Council under the Public Health Act, 1891. As the two-gallon flush, under the conditions laid down in those regulations, was not effective in clearing the closets, it was necessary to increase it to three. Moreover, the Companies, it should be noted, did not object to the larger flush where the supply was by meter. A considerable number of witnesses for the Companies had asserted that, where the fittings were "proper" in each and every particular, two gallons were sufficient; but these conditions were such as were not met with in every-day life. The same remark applied to the experiments that had been made. He did not suggest that the experiments of the Kent Company or the New River Company were not as honest and reliable as those of the Sanitary Institute; but neither one set nor the other could compare with the evidence of daily practice. Then the Companies alleged that the introduction of the combination closet had resulted in a great increase in the water used, owing to the closet being flushed whenever it was used for urination purposes—this being one of the causes of the great general increase in the consumption of water of late years. Baths had, however, come into use to a much greater extent than formerly; and they had contributed greatly to the increase. According to some of the evidence, the extra consumption arising from the use of the third gallon would mean an increase of 15 million gallons daily over the districts of only six of the Metropolitan Companies. This meant that every man, woman, and child in the Metropolis would make from two to six visits to the closet each day—the estimated number of visits varying with different witnesses. This, of course, was ridiculous, especially when they remembered that the father and children were absent nearly all day. Against the increase that would occur, they had to set the saving in the case of the man who used a two-gallon flush twice—consuming four gallons to effect what one three-gallon flush would suffice for. In conclusion, Counsel said this matter had been taken up by the County Council under a serious sense of responsibility, and was supported by a very strong body of opinion; and he asked the Inspector to say that the remedy he had suggested, simple in character and efficient in its result, should be applied to the present unsatisfactory state of affairs.

The INSPECTOR then expressed a wish to be allowed to examine some of the closets at the various dwellings that had been referred to; and it was arranged that, accompanied by representatives of the Water Companies and the London County Council, he should visit a number of these buildings.

The proceedings then terminated.

BRADFORD CORPORATION WATER SUPPLY.

The Arbitration in Connection with the Nidd Water Scheme.

As already mentioned in the JOURNAL, arbitration proceedings were commenced at the Surveyors' Institution on the 15th ult., before Mr. C. OAKLEY, in regard to a claim made by Mr. Thomas E. Yorke, of Pateley Bridge, upon the Bradford Corporation, for a sum of about £45,000, compensation for a certain easement and land required in connection with their Nidd Valley water scheme. The claim had been referred to Mr. T. Fenwick, M.Inst.C.E., for the Corporation, and to Mr. J. Waugh for Mr. Yorke; and as these gentlemen could not agree upon an Umpire, the Board of Trade appointed Mr. Oakley. The easement in question comprises a strip of land about eight miles long and six yards wide—in all, some 18 acres—reaching from Rainstang, in the township of Stone Beck, up through Appletreewick to Ashfold Sire, in the township of Stone Beck Down. Close upon three miles will be used for a tunnel at a depth of 400 feet below the surface of the ground; and nearly four miles will be in cut-and-cover, having an average depth of 12 feet. Smaller quantities of the land will be used as follows: 1249 yards for pipe-tracks to be laid at an average depth of 6 feet; and 2417 yards for branch pipes, at an average depth of 4 to 5 feet. The claimant, in his notice of claim, alleged a variety of grounds for compensation—viz., severance of lands, rights of ingress and egress for the Corporation, damage and injury to shooting and other sporting rights, damage through loss of water, the power to take which the Corporation have gained by Act of Parliament, injury to mines and minerals, and additional cost of getting and dealing with such mines and minerals. Among the objections raised by the Corporation are these: That, as to the alleged severance of lands, the greater portion of the works will be underground; and as to the parts above ground, they will consist of bridges and other works across streams, not causing any severance. The Corporation hold that, as to the right of ingress and egress, the income of the owner of the land will not be interfered with; as to shooting, the ground is not suited for birds, and the rent of such land would be nominal; as to water, that the only serious question of compensation is as to one corn-mill; and a general negative with regard to mines and minerals.

Mr. BALFOUR BROWNE, Q.C., and Mr. W. J. WAUGH appeared for the claimant; Mr. CRIPPS, Q.C., M.P., and Mr. FREEMAN represented the Corporation.

Mr. BALFOUR BROWNE, in opening the case, said Mr. Yorke's claim was not for the value of the land *per se*, but for compensation for taking a strip eight miles long out of the very centre of his estate, and putting in a foreign owner whose rights would affect the property very seriously. The main element of compensation was that, at the present time, Mr. Yorke was the owner of this estate absolutely; while, in future, right through the centre of the land there would be a new and another owner. The Umpire would know what an enormous sum a landowner now and then had given, in order to get rid of some small proprietor with an insignificant farm in the centre of his estate. One of the witnesses he would call would say that, if it had been a case of merely laying this pipe down and never touching it again, or interfering in any way with Mr. Yorke's rights, there would have been practically no compensation. But he could show that, by having this foreign proprietor in the midst of the land, with large powers to prevent Mr. Yorke from doing all he had done before, the damage to the estate was very considerable indeed. As to the matter of ingress and egress, it appeared at first sight a small one; but there was a good deal behind it. If a section of the conduit broke down, and new pipes had to be inserted, the workmen could not be expected to go to the top of the valley and come down the eight-mile strip of land, nor would it be feasible to take the pipes by such an extraordinary route. The Corporation would have a right of way, by necessity, in such case over the claimant's land; and the pipes could be carried by the nearest available route. That right of way must be paid for. Then with regard to the shooting rights, after the construction of the works, there would be disturbance of the game—the shooting would not be the same. There was a lead mine which would be affected by the conduit, because the water would be drawn off by which the lead was washed. From that mine, Mr. Yorke drew a royalty producing an annual income of £1000. The washing of the lead polluted the water; and therefore it would not be legal any longer to wash it. If the Bradford Corporation, by Act of Parliament or in some other way, would make it as legal in the future as it had been in the past to wash this lead, Counsel would take £15,000 off the claim. If the washing were stopped, Mr. Yorke's income of £1000 a year in this direction would cease; and the Corporation must pay compensation.

Evidence was then called in support of the claim.

Mr. *F. Phillips*, of Pateley Bridge, Mr. Yorke's agent, said there was a smelting-mill and lead mine on the estate at Lolly Scar. Mr. Yorke's revenue from these works last year was £1100, which included a royalty of one pig out of twenty; but it comprised also the lead left in the smelting-flue. In consequence of the building of the tunnel through the estate (which work was in progress), the water supply at four farmhouses had already been diminished.

In cross-examination, witness said the nearest washing would be a mile from the Corporation's works.

Mr. *J. Newbold* and Mr. *J. Atkinson*, tenants of farms on Mr. Yorke's estate, testified that, since the construction of the Corporation conduit, their supplies of spring water had been injuriously affected.

Mr. CRIPPS said the Corporation were not responsible in the way suggested by claimant's Counsel until the works were completed. The remedy lay against the contractor.

Mr. BALFOUR BROWNE contended that the Corporation were responsible during the construction of the works; but the point was one which could not be settled then.

Mr. *W. B. Woodhead*, of Bradford, gave a history of the Nidderdale estates since their purchase by Sir John Yorke in the year 1546. He said the chief hardship upon Mr. Yorke was that these works were laid out in such a way that the whole of the water would be taken into the conduit, and conveyed to a gauge-point, where 17 million gallons would go forward to Bradford, and the rest would pass down to the compensation reservoir. Of the land now required, two acres were for permanent works, and consisted of 51 patches. The damage done to the estate in this way would be very serious. The easement was 14,454 yards, with a width of about 6 yards. It carried with it the rights of repair and alteration, and substitution of tunnels, pipes, &c., a perpetual right of way over the whole distance, day or night, and with or without horses and vehicles, and the power of preventing Mr. Yorke and his successors in title for ever from building on this land or planting trees thereon. These rights could not be exercised without detriment to the estate. In the course of the eight miles, the conduit crossed seven principal streams, of which the Corporation took six. The taking away of the 17 million gallons of water meant withdrawing practically the whole of the summer water from the area crossed by the easement. He put down £5000 as compensation for the easement and the incidental damage to the estate; and £1530 for 51 detached plots of freehold—together, £6530. Adding 10 per cent. for compulsory sale, brought the amount up to £7183. As to the shooting, fishing, and sporting rights, the fishing had gone entirely, and the shooting right was spoiled. He considered that the rent of the sporting rights would be reduced by £100 a year; and multiplying that by 25 years' purchase gave £2500. As to the ingress and egress, this was a more difficult question. But the land was in six or seven valleys; and for access to the workings of the Corporation, some seven miles of right of way along these valleys would be given over to the use of the Corporation for all time. Taking the compensation for this at £500 a mile, he made £3500 on this head. As to the sheep-washing, the landowner would have to provide an artificial supply of water, with tanks and other works; and calculating that six of these would have to be constructed, at a cost of £400 each, with £100 for somebody to look after them, gave £2500. It was also claimed, on behalf of Mr. Yorke, that his mineral industry, as to which figures had already been given, would be destroyed; and for this £15,000 was put down in the claim. The value of the two mills involved was not large. He had put them at the nominal rent of £30 each, which at 18 years' purchase came to £1080. He also considered that the water on the estate that was not in running streams was of value to Mr. Yorke. The Bradford Corporation were taking 17 million gallons, which sold for 9d. per 1000 gallons. If the Corporation had not needed the water, somebody else might have wanted it. Taking it that Mr. Yorke had one-tenth of this water, or about 1⅞ million gallons, to deal with, and putting the value of the water at the lowest price he had ever heard of—viz., ¼d. per 1000 gallons—it would yield an annual value of £638, or capitalized at

20 years' purchase it meant £12,760. All these claims together brought up the total to about £44,500.

Mr. CRIPPS remarked that the original claim was for £35,000; and he asked why it had been raised to £45,000 within 24 hours.

Witness said he was told on the previous night, by Mr. Balfour Browne, that there was a proprietary right in the water; and he was asked to supply the figures as to its value. So he took 1-10th of the water Bradford was getting, and 1-36th of the price they were receiving for it.

Mr. *R. Horsfall*, a surveyor of Halifax, said Mr. Yorke's estate would seriously suffer through the interception of the streams and springs by the Corporation. He valued the proprietary rights of the claimant to the underground water on his estate at the same figure as Mr. Woodhead, with whom he had discussed the matter.

In cross-examination by Mr. FREEMAN, witness said the consequential damage in connection with the easement was the fact that mining below the conduit would be stopped, and that no buildings or trees could be put above it. This damage he estimated at about £6000. The value of the land taken would be only a small fraction of that amount.

Mr. *J. Waugh*, the Arbitrator appointed by Mr. Yorke, said on the question of dual ownership, if the pipe now existed, he would advise him to pay £5000 to get rid of it and its foreign owner. The abstraction of water from the streams was a very serious matter for Mr. Yorke. The Corporation had a right to take 97 streams. The land on the lower side of the conduit would be much depreciated through losing the streams. The Corporation, after taking their 17 million gallons, sent back the surplus, not into the streams, but to the Gowthwaite reservoir. The Corporation had certainly to provide water for domestic and agricultural purposes; but such provision was not an adequate substitute for the natural supply of streams and springs. As to the sheep-washing on Mr. Yorke's estate, there could be no washing above the conduit, because it would pollute the streams; and there could be no washing below it, because there would be no water. Mr. Yorke received £280 in rent for shooting. With what Mr. Yorke shot over himself, he estimated the total rental for the acreage involved at £700 a year; and he considered this total rental would be depreciated to the extent of £100 a year. With regard to the underground water on Mr. Yorke's estate, he believed it would be more than one-tenth of the total quantity taken, as estimated by Mr. Woodhead, because there were hundreds of valuable springs in the district; and he was also himself of opinion that the water was worth ½d. instead of ¼d. per 1000 gallons. In his judgment, the loss of water in connection with the farms justified a claim of £500.

Mr. CRIPPS, in opening the case for the Corporation, said the claim was one of the most hugely exaggerated ones with which he had had to deal; and he said this because his view was that the amount to which Mr. Yorke was entitled was only between £3000 and £4000. The demand for £15,000 in connection with minerals was altogether outside the arbitration, because the Corporation did not intend to stop the lead-washing, which they did not think would affect the Gowthwaite reservoir. With regard to the claim of £12,000 for the underground water on the estate, he contended that it was not worth a farthing; and the very suggestion of compensation for it was an absurdity. On the point of law, also, the claim was bad. As to the loss to the farms, Counsel submitted that the Umpire could not consider the matter, because the Corporation could not take any water until after the compensation reservoir had been built. They had no power to take the water from these farms; and therefore, if the water was being withdrawn from them, the tenants had good ground for an action against either the Corporation or the contractors. But their claim was altogether outside and beyond the present arbitration. The same argument applied to the sheep-washing claim. Coming to the claims which the Corporation considered were questions of amount, the Corporation were quite willing to allow between £400 and £500 for the corn-mill and the saw-mill, which was all anyone would give after seeing them. As to the consequential damage from the easement, there was really none, except in relation to the shooting, for this was merely moorland, and the pipe seldom came to the surface. The permanent injury to the shooting could be only very small. The works were chiefly tunnelling and cut-and-cover, with a few manholes; and did the fact that a Corporation official would pass over the line of easement two or three times a year mean that Mr. Yorke's shooting rental would be depreciated by £100 a year? Besides, if Mr. Yorke asked specially that the official should not come along the line of the easement while he was shooting, the matter could be easily arranged. As to the building and planting of trees, he did not suppose the inability to carry out these operations along the line of easement in a district like the one in question was ground for compensation. He did not like to commit himself to figures; but, looking at the matter all round, he could not but think that the utmost compensation Mr. Yorke was entitled to for the laying of this tunnel through his land, and of making permanent works over the two acres, was a sum of between £3000 and £4000.

Mr. *J. Watson*, M.Inst.C.E., the Water Engineer to the Bradford Corporation, said the water-works administration in Bradford had never paid; and the suggestion of the other side that it was a profitable undertaking was wrong. He produced the parliamentary map of the works, signed by Lord Belmont, showing that Burn Gill and the Lolly Scar lead mine were both in the compensation area. The pipe which was now being laid would carry 10 million gallons a day. This would convey as much water as the Corporation would want for 25 years to come. The cut-and-cover work would carry 22 million gallons a day. A slight deviation was being made in the direction taken by the conduit as compared with the original plan. But he had Mr. Yorke's verbal assent to it; and he also received a telegram to the same effect from his assistant, who had a formal interview with Mr. Yorke on the subject. Of the eight miles of easement now being sought, a length of 4687 yards was in tunnel at a depth of 400 feet and upwards below the surface of the ground, and a length of 6085 yards was in cut-and-cover, having an average depth of 12 feet. Witness gave other statistics as to the easement works, showing that they were nearly all underground. He said the works, so far as opened out, at no part disclosed evidence of minerals of any value; the prevailing characteristics being sandy clay, shale, and millstone grit, which constituted almost entirely the formation of the strata throughout the whole length of the land in question. Such materials were not of any commercial value to Mr. Yorke. In reference to the £12,000 which the claimant asked for underground water, the Corporation did not touch that water. Of the 97 streams which the Corporation had the power to absorb, they only took seven on Mr. Yorke's estate. With the exception of these streams, the Corporation did not take any surface water from the estate. He could not conceive the possibility of collecting the underground water and selling it. It was one of the most absurd proposals he had heard.

In cross-examination by Mr. BALFOUR BROWNE, witness said he should not object to the lead-washing water going into the Nidd, and afterwards into the Gowthwaite reservoir. Those interested in the stream had never objected so far; and there was no reason for upsetting the present state of things. The Lolly Scar lead mine was a mile away from the Gowthwaite reservoir. The streams absorbed by the Corporation were by no means largely supplied by springs. Instead of a hundred, he could only find in the district six springs on the Ordnance Map. He admitted that the seven streams taken by the Corporation were fed by a few of the 97 streams which the Corporation had the power to take; but they were not on Mr. Yorke's estate.

Re-examined by Mr. FREEMAN: The deficiency on the water-works accounts for several years had been made up out of the gas profits.

Mr. *C. Gott*, M.Inst.C.E., formerly the Water Engineer of the Bradford Corporation, said his valuation came to £2862. This did not include anything for the shooting, because, from his experience on the subject in connection with other moorlands on which the Corporation collected water, the works did not in any way interfere with the game, nor did the workpeople; and, further, the Nidd conduit—the subject of the inquiry—was outside the grouse moor area. The sheep-washing would not be affected. It was only an occasional operation; and if at the time the stream happened to be dry, the Corporation would be bound by law to supply water. The lead-washing was a matter in which the Corporation were not interested, because the water went into the Nidd. As to the getting of minerals generally, the work of the Corporation would not affect the estate. The suggestion that Mr. Yorke could collect the underground water in the district and sell it, was altogether impracticable.

Cross-examined by Mr. BALFOUR BROWNE: Apart from the fact that the water went with it, this land would not be worth twopence; and therefore his valuation included compensation for the water. If it had not been for the water, the Corporation would not have wanted the land at all.

Mr. BALFOUR BROWNE: Do you mean to say that the 5 million gallons of water a day which you will take from this estate are not worth more than £2862?

Witness: Mr. Yorke cannot sell it, and does not sell it. We have made bargains more favourable to the Corporation than this with regard to other areas in connection with these same works.

Mr. *F. Fowler*, a surveyor, of Sheffield, said his estimate of the amount which should be paid to Mr. Yorke was as follows: For the tunnel easement, £434; for the conduit, 284 chains at £3 and 160 chains at £4, which made £1492, or a total of £1926. He had estimated the value of the freehold taken at £150 per acre, and there being two acres, this would make a sum of £300. The damage to the saw-mill and corn-mill he put at £450; the damage to the sporting rights, at £300; and to trees, at £30. This made a grand total of £3006. In his opinion, there would be no interference with lead-washing or the getting of minerals.

Mr. *J. Smith*, a surveyor and valuer of 45 years' standing, said he had made a joint valuation with Mr. Fowler, and practically agreed with him in his estimate of the amount to be paid to Mr. Yorke in respect to the easement and the damage to his estate.

This concluded the evidence; and the proceedings were adjourned.

On the resumption of the inquiry on the 12th inst., the Umpire was addressed by Counsel for both parties; and he stated that he would carefully consider his decision—the case being a complicated one—and give it before Christmas.

The Opposition to the Welsh Water Scheme for London.—At the monthly meeting of the Newport Harbour Commissioners last Wednesday, letters were read from the Monmouthshire Conservators relative to the London County Council's water scheme, and opposition suggested. A letter was also read from Mr. T. Canning, stating that the scheme would kill the Usk. The Chairman said the project would destroy the Usk as a fishery river; and he did not see why a matter of something like 10,000 or 12,000 salmon should be done away with. With regard to manufactories, the scheme would materially affect them. Newport would be much injured, too, with regard to the water for the docks. A Royal Commission had pronounced against the scheme. It was decided that the Commissioners should take measures to arm themselves] with information with the view of opposing the project, if necessary.

Water-Works Extension at Tonbridge.—The Tonbridge Water Company have just completed a most important extension of their undertaking. During the last twelve months, they have constructed three new wells, each 10 feet diameter, with the result that a bountiful supply of excellent water is now obtainable; and on Friday last the Chairman of the Company (Mr. J. Fagg) started the new horizontal duplex compound condensing pumping-engine, erected by Messrs. J. H. Carruthers and Co., of Glasgow, to replace the machinery no longer suitable for the requirements of the rapidly increasing district. Mr. Fagg said it was a pleasant duty for him to take part in the proceedings, the event being an important one in the history of the Company. Engineering was making great strides; and he claimed that the Company were in possession of the most improved and up-to-date appliances for pumping and distribution. The Directors were certainly to be congratulated on having obtained an ample and unlimited supply of good water; and much credit was due to the able management of their Engineer (Mr. J. Lees), who had rendered such excellent service since his appointment in the spring of last year. We may add that the engines and wells are highly satisfactory, the engine-room has been remodelled and greatly improved, and considerable additions to the mains are being carried out.

SHEFFIELD AND THE LITTLE DON WATER SCHEME.

The Water Committee of the Sheffield Corporation recently had before them correspondence between the Corporations of Sheffield, Rotherham, and Doncaster on the question of an extended agreement respecting the water supply of the Little Don Valley, already referred to in the JOURNAL. This having been read, and the Chairman having reported as to the interviews that had taken place, it was resolved as follows:—

(1) That a further agreement be entered into between the three Corporations of Sheffield, Rotherham, and Doncaster, so as to provide that the terms of the agreement of June 12, 1895, shall apply to a scheme for the utilization of the whole watershed of the Little Don, and with regard to the cost of filtration works and maintenance of the same, and of other works in connection therewith; and that the seal of the Corporation be affixed to such further agreement.

(2) That the Sheffield Corporation in the session of Parliament of 1896 do promote a Bill asking for power to construct reservoirs and do other works in the valley of the Little Don or Porter River, and thereby to intercept and impound the waters of that river and its tributaries, for the supply of Sheffield, Rotherham, and Doncaster, in accordance with the agreement already existing between these Corporations, and dated June 12, 1895, and the last-mentioned supplemental agreement; to lay such mains as are mentioned in the said agreements; and to do all necessary works to enable the Sheffield Corporation to carry out their engagements under such agreements.

(3) That such Bill be so drawn as to include the right out of the water proposed to be impounded by the Sheffield Corporation from the Little Don Valley to supply the Corporation of Barnsley with water, in accordance with the offer contained in the letter addressed by the Town Clerk of Sheffield to the Town Clerk of Barnsley, dated the 24th day of October, 1895.

The Town Clerk (Mr. H. Bramley) laid before the Committee the draft parliamentary notice for the promotion of the above-mentioned Bill, and, with certain alterations then proposed, it was agreed to.

PROPOSED NEW WATER-WORKS FOR BASINGSTOKE.

Local Government Board Inquiry.

Last Friday, Mr. F. Tulloch, C.E., continued an inquiry, on behalf of the Local Government Board, in connection with an application of the Basingstoke Town Council for power to borrow a further sum of £16,000 for the construction of water-works. Considerable interest was aroused in the proceedings, on account of the very strong opposition which has been raised against the scheme; this feeling having been accentuated by the defeat of Mr. A. Dowling, the Chairman of the Water Committee, at the municipal elections held since the inquiry was opened.

The TOWN CLERK (Mr. W. H. Bayley) informed the Inspector that in 1883 the Corporation purchased the present undertaking from the Water Company; but though some of the plant went with the purchase, neither the well nor engines did so, as it was the intention of the then Town Council to erect proper works of their own. They consulted Mr. T. Hawksley on the matter in 1885; and a scheme was prepared, but it was considered too expensive to proceed with. The present works consisted of a well with headings in what was known as the Dell The engines and boilers used for pumping the water were leased by the Corporation; and the water was pumped to a reservoir on the northern side of the town—a stand-pipe being kept, over which the water was pumped in order to supply, as far as possible, the high levels of the town. There was a consensus of opinion that there should be an extended service in the hands of the Corporation; and in February, 1894, Mr. Rofe was instructed to prepare a scheme, which was the one now under consideration.

Mr. *Henry Rofe*, M.Inst.C.E., said he acted for the Basingstoke Corporation when they purchased the existing works in 1883; it being then admitted that new ones were absolutely necessary, at an expense put by Mr. Quick, the Engineer engaged in the arbitration, at £6447, of which £1000 was estimated as the cost of a high-service tank to supersede the objectionable mode of supplying the high levels by means of a stand-pipe. In February, 1894, the Corporation consulted witness, who then found that, though a new reservoir had been constructed, the high-service tower had not been carried out; the stand-pipe being still in use. In 1881, the average daily supply of water for all purposes was 263,194 gallons; in 1891, the quantity was 290,000 gallons; in 1892, it was 322,000 gallons; and in 1894, 400,000 gallons. To meet this increase, he should advise the erection of a pumping-station capable of supplying 750,000 gallons a day (by the putting down of two engines), in the proportion of two-thirds to the low-level and one-third to the high-level reservoir.

The INSPECTOR asked if the old works would be abandoned in the event of the new ones being carried out.

The TOWN CLERK replied in the affirmative.

Witness (continuing) said the new reservoir would hold 250,000 gallons, or one day's supply to the high levels. The new well had been sunk into the chalk at Sherborne; and he would say that 400,000 gallons at least had been pumped out of it per day, and if he wanted 2 million gallons he would be content to go into the same area. He estimated the cost of pumping a million gallons at the new works at £2 17s. 6d., or 0·69d. per 1000 gallons. The cost of pumping and distributing a million gallons at the old works was £7 16s.; whereas at the new works it would be £5 14s. 6d., including wear and tear of machinery, and all other incidentals.

Mr. *J. Whitaker*, F.G.S., of Southampton, said he considered the proposed new works would be a vast improvement on the existing ones, which, being in an inhabited area, with the ground-level not a great way above the water-level, might easily lead to an absorption of impurities from the surface or from cesspools around.

Mr. *J. Edney*, the President, and Mr. *A. H. Barton*, the ex-Captain of the Fire Brigade, testified to the inadequate supply of water available under the existing arrangements in case of an outbreak of fire.

Mr. *A. Dowling*, the ex-Chairman of the Water Committee of the Corporation, said he considered the old system of pumping was bad, dangerous, and totally unequal to the present requirements. Many complaints had been made about the inadequate supply to the higher parts of the town; no water being available except when they were pumping over the stand-pipe. Mr. Rofe's first estimate for the proposed extension was £6000; but when the scheme was more thoroughly gone into, it was altered to the present figure.

Mr. *S. Bird* contended that the changes were made without the sanction of the Town Council, who merely considered a scheme limited to the provision of a new pumping-station which was to cost about £6000. When Mr. Rofe's latest proposal was received, it was a complete surprise to everybody. A scheme of such magnitude was never dreamt of, and would not have received a second thought if Mr. Rofe had not emphatically declared that the Local Government Board would not sanction a loan for a scheme which did not provide for a constant supply of water to the high-level districts, and that he personally could not undertake one which did not furnish it.

Mr. *H. Smith* said a public meeting had unanimously declared against the scheme, as unnecessarily elaborate and expensive under the circumstances. It would cost nearly £20,000; whereas if his (Mr. Smith's) scheme were adopted, it would not exceed £6000. His figures worked out as follows: New well and adits at Sherborne Bottom, £1800; engines and pumps, £2900 (engines to be in duplicate, and capable of pumping 30,000 gallons per hour); cost of inquiry and professional charges, £150; annual cost of pumping over the stand-pipe, £937; and there would be the cost of the land, &c. He did not hesitate to say the existing plant at the old works would last another twenty years; and at a previous inquiry, evidence was adduced to show that the water-works were then substantial in every way.

The inquiry then closed.

THE OLDHAM CORPORATION WATER-WORKS.

On the occasion of a recent visit of the members of the Oldham Corporation to their water reservoirs, a description of the various works was distributed among them; and from it we take the following: At Strinesdale, there are two reservoirs, which were constructed under powers obtained in 1825 and 1838. The drainage area of 660 acres has been lately rejected, owing to the many farms, &c., on the gathering-ground rendering the water flowing therefrom objectionable for domestic use. The dilapidated and unsafe condition of the old watercourse has made it compulsory on the Water Committee to renew it without delay. The work is in hand, and is estimated to cost £3500. At Castleshaw, the ceremony of cutting the first sod was performed on May 25, 1887; and the works were opened on Sept. 30, 1891. The water is conveyed to Strinesdale in cast-iron pipes, 30 inches in diameter, and about 4½ miles in length; 1½ miles being laid in the tunnel passing under High Moor. The drainage area is 950 acres; and the aggregate storage capacity, 389 million gallons. The cost of the works, inclusive of land, has been £226,100. At Denshaw, the first sod was cut on July 26, 1876; and the works were opened on July 26, 1883. Recently Dowry Castle and Rag Stone Estates have been purchased at a cost of £8760. The drainage area is 1350 acres; and the aggregate storage capacity is 381 million gallons. The total amount expended, inclusive of land, has been £253,552. At Rooden, the first sod was cut on July 30 last year. Owing to the physical features of the ground, two embankments are required to form the reservoir, which was estimated to hold 225 million gallons. The peat and other excavations removed from the bed of the reservoir will increase the capacity by 20 millions. The reservoir has no drainage of its own, with the exception of 25 acres; but a projected tunnel from Ready Con Dean Brook, and an intended watercourse to intercept the two main streams in Piethorn Valley, will deliver into the reservoir the rainfall from 778 acres of moorland. In wet seasons this water has formerly run to waste. Puddling in the northerly trench is now proceeding. A depth of 83 ft. 6 in. had to be excavated before reaching solid strata; and excavations are proceeding in the southerly trench. The construction of this reservoir completes the series for which statutory powers were obtained by the Corporation in 1886. The estimated cost is £89,256. The Act of Parliament for the construction of the Piethorn works was obtained in 1855. The watercourse on the north-westerly side of the valley is being reconstructed at an estimated cost of £1750. The embankment of the Ogden reservoir was recently raised 10 feet; thus providing an additional storage of 64 million gallons, at a cost of £21,662. This sum includes the purchase of the property at Spring Mill. The aggregate storage capacity of the reservoirs in Piethorn Valley is 696 million gallons; and the drainage area is 1820 acres. The Brushes Clough and Besom Hill reservoirs and conduit were constructed under powers obtained in 1855. The area of the gathering-ground is 700 acres; but, on account of land cultivation, the water from one-half this area is not collected. The total amount expended on the water-works at March 25 last was £1,064,487.

The Water Supply and Sewerage of Linslade.—The Linslade Parish Council, at a meeting on Friday, the 8th inst., awarded the first premium for the competitive designs for the sewerage and water supply of the district to Messrs. R. F. Grantham and Son, Northumberland Avenue, London, and the second premium to Mr. H. B. Nichols, of Birmingham. The rateable value of the district is about £20,000; and the estimates of cost varied from £3200 to £9900.

The Okehampton Town Council and the Gas-Works.—Some time ago the Okehampton Town Council opened negotiations with the Gas Company with a view to the purchase of their works and rights; and at a meeting of the Council yesterday week, the reply of the Company was read. They said that, after consideration, they were willing to sell the works to the Corporation for £3000, exclusive of the gas cooking-stoves. Alderman Passmore moved that the letter be referred to the Lighting Committee, and said the Company had asked about 100 per cent. more than their works were worth. The motion was agreed to.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

Few headlines in a newspaper are more effective in the matter of arresting the attention of the ordinary reader than "An Explosion of Gas," more particularly if the word "Alarming" can be inserted in it, which it nearly always is; and consequently the ordinary reporter, catering for, if not creating, the tastes of his readers, is not slow to serve up very highly magnified accounts of such occurrences. The close of the last sentence, I am sorry to say, is not by any means confined to accidents which have a connection with gas, but may be applied to the whole range of journalism. A local newspaper may generally be relied upon to give a fair account of any occurrence, so far as the capacity of the writer will carry him; but there are in the ranks of that class of journalists who are known as correspondents, many unscrupulous gentlemen who spice up their paragraphs to such an extent that they are altogether useless for their only purpose, which is to give information. There are two reasons for this state of matters—first, the introduction of the new journalism, which aims at telling a good story, irrespective of the facts, in order to make a sensation, of which you have several examples in London; and, second, in the case of correspondents who are paid by the line, the scramble to get their communications accepted. The latter works out in this way: Suppose a fall of snow—say, of one inch—takes place, every correspondent will be sending in an account of it. There is not space for them all, and the man who tells honestly that it was only one inch will have his manuscript relegated to the waste-paper basket; while the one who can make it four or five inches will have his accepted. If a gale of wind blows, the man who can make it the most terrific gets the pennies for his lines. There is thus a great temptation to exaggerate; but more's the pity that it should be taken advantage of, because the result is to shake the confidence of the public in accounts which they see in newspapers.

Of gas explosions, I have three on my list this week—one at Forfar, one at Aberdeen, and one at Hamilton. So far, the Aberdeen one was the most serious—not perhaps the most violent—in respect that the cause which led to it also led to the loss of a man's life. The man was a labourer, who lived alone in a one-roomed house. He had not been seen since Sunday; and on Wednesday afternoon a lad was sent by his relatives to see why. The door was not fastened; and the lad, on entering, found the house in darkness. Noticing a strong smell of gas, he, without thought, struck a match; and an explosion occurred, which could not have been very violent, as it only blew out several panes of glass in the windows, disturbed some furniture in an adjoining house, which was separated from this one by a partition, and singed the lad's hair. The occupant of the room was found lying dead on his bed. He had been dead for some time; his death having been due to suffocation by gas. Some of the neighbours perceived a smell of gas from Monday onwards, but called no attention to it; and their carelessness probably lost the man's life. As in so many other cases where fatalities from gas occur, no gas was used in the house; but it had been at one time. When the gas-meter was taken away, the end of the service-pipe was soldered up, for which care the Gas Manager (Mr. Smith) deserves to be commended; because it is not uncommon to have the end simply battered flat. In this case, the service-pipe ended in a cupboard; and the occupant of the house having used the cupboard as a receptacle for coal, it is concluded, I think with safety, that the end of the gas-pipe had been fractured either by the tumbling of the coal in or by the shovelling of it out—most probably the latter. This story, as taken from a local paper, is moderately told, and bears on the face of it that it is accurate.

The explosion at Forfar was the most interesting to your readers, as it took place within the gas-works; and the young Manager of the works (Mr. Forbes Waddell) was at first reported to have narrowly escaped with his life. This, however, according to the latest information, turns out not to be the case; but it is by no means the only exaggeration which was published regarding the affair, in the manner of which I have written above. The occurrence took place shortly after ten o'clock on Monday night; and my attention was first called to it by a Glasgow newspaper on Tuesday morning. The account was very alarming; the expression occurring that "the loud report and the crashing of masonry and glass alarmed the town." But a Dundee newspaper, apparently served by the same man, improved upon this by adding that, "so loud, indeed, was the report that it shook the houses in the locality, and was heard a considerable distance from the town. Following the report, an escape of gas took place, which caught fire, and brilliantly lighted up the surrounding district." It was added that "the retort-bench was entirely wrecked, while the retorts adjoining were also considerably damaged;" that "the pipes of the retort-bench, which measured 12 feet by 9 inches, and weighed about half a ton, were completely destroyed;" and so on. The inference was that the gas-works were almost in ruins. It is considerable relief, therefore, to learn, through more moderate sources, that the damage which was caused by the explosion may be covered by from £25 to £30. So far as I can discover, what took place was this: Last summer Mr. Waddell had a new retort-bench erected on a regenerative system which was to a large extent his own. The settings were in fives; but there was one setting of four retorts, which had been in use during the autumn, when the consumption of gas was not so large as it is now. When the larger settings were put in operation, the small one was let down. Mr. Waddell had resolved to bring it into use again; and on Monday, after seeing to the night pressure, he went to look after the lighting up of the small oven. It is said that when he opened the door of a retort (by which I presume is meant the furnace door), gas which had accumulated inside exploded. Mr. Waddell's account has not been issued yet; and as only he and one of the workmen, named Stark, were in the retort-house at the time, it is not very clear what took place. There was, however, an explosion which was something more than the "bluff" which is frequently heard when a retort is opened; and there would be a considerable outburst of flame. Part of the front of the oven was blown out; and two ascension-pipes were brought down. That seems to have been the full extent of the damage to property. Unfortunately, Mr. Waddell, who was working at the oven, was hurt by the falling bricks and pipes, and was rather seriously burned. The other man was injured, but much less seriously. Mr. Waddell was found lying on the floor of the retort-house in an unconscious condition; and was carried into his residence, which adjoins. He shortly recovered consciousness; and the latest report about him is that he is progressing favourably, which everyone will be glad to hear. It is a most unfortunate accident, if for no other reason than that it will give a handle to those members of the Corporation who are not too friendly to Mr. Waddell. The cause of the explosion is said to have probably been the wheeling of a barrow of coke past at the time the door was opened. That is not a satisfactory explanation, as, if it had been the case, the barrow would have been there to show that it was so. I have a belief that it happened in another, and quite a natural way; but until Mr. Waddell gives his version, I think it better not to put forward my view. Mr. Waddell's brother, Mr. A. Waddell, who is Manager of the Broughty Ferry Corporation Gas-Works, was sent for the same night; and he saw to the work being continued. Thereafter Mr. Peter Thorn, the clerk at the works, under the direction of the Gas Committee, took charge of the works. Arrangements are already being made for the restoration of the damaged portion of the oven, and of the glass in the roof which was broken.

The third explosion, at Hamilton, took place on Thursday afternoon, and was of a very trifling nature.

On Wednesday morning fire broke out in the Barrhead Gas Company's works. The stokers were cleaning a choked pipe from an oil-gas retort, when the escaping gas ignited the roof of the retort and boiler house. That part of the roof, despite prompt exertions on the part of the Manager (Mr. J. W. Carmichael) and his staff, was destroyed. The damage done is estimated at about £100.

Bailie M'Hale has been appointed Convener of the Gas Commission at Hamilton, in room of Mr. Brown, who has left the Council. The new Commissioner will probably give me more to do than the old one did.

Tenders were lately received by the Glasgow Corporation Sub-Committee on Gas-Works for the timber framing, &c., required in connection with the large gasholder which is about to be erected at the Tradeston Gas-Works, and for which the tank is now in course of construction. The three lowest offers were sent to the measurers to be checked; and the Secretary was authorized thereafter to accept the lowest tender. Messrs. Lamb and Stewart, of Glasgow, have been successful in securing the contract. Eleven tenders were sent in for the supply of the timber required for the supporting framing, and for the execution of the work in connection therewith.

Some weeks ago, a man named Robert Dunn, labourer in the pipe-store at Howard Street, Bridgeton, belonging to the Glasgow Corporation Gas Commissioners, met his death by accident, when helping the foreman (his own brother-in-law) to move some large pipes. Application was made by his widow to the Gas-Works Sub-Committee for compensation; and an inquiry into the circumstances was made by the Convener of the Committee, along with Mr. Fife and the Law Agent. In their report on the matter, they recommended that (without admitting legal liability) the Corporation should pay the funeral expenses of the deceased, and also a sum of £150 to his widow for herself and her children. The recommendation has been approved of and acted upon.

The Portobello Gas Company have replied to the Town Clerk of Portobello, who had written asking a reduction in the price of gas supplied to public lamps, that in consequence of the cost of the upkeep of the lamps, and the exceptionally heavy outlay upon street improvements recently, the Directors do not see their way to make any reduction upon the existing terms.

Parliamentary notices are appearing this week. There is to be nothing very large, either in connection with gas or water, from Scotland this year. The largest is the scheme for the extension of the boundaries of Edinburgh, so as to include the towns of Leith and Portobello, as well as a large slice of the county of Mid-Lothian. Were the measure to pass—which I suppose not even the most sanguine of its promoters expect will happen in the next session of Parliament—the area of gas and water supply would then be practically coterminous with the city boundaries. It is therefore proposed to take power to compulsorily acquire the undertaking of the Portobello Gas Company; and also to merge the Gas Commission and the Water Trust in the Town Council—the officials and employees of those bodies becoming Corporation servants. The measure will most probably be opposed by the Leith Corporation, and, formally at least, if not more forcibly, by the Portobello Gas Company. The Corporation of Portobello seem, as yet, to be favourable to the proposal, if they obtain the terms they wish.

The Falkirk and Larbert Water Trust have given notice of a Bill to empower them to augment their water supply, which is to be effected chiefly by raising the levels of the existing reservoirs. The scheme is likely to be opposed, unless along with it there is an extension of the area of compulsory supply.

The Bill which the Dundee Corporation were proposing to introduce, the principal provision of which was to have been the taking of power to borrow money in connection with the gas undertaking, has been abandoned for this year. When the Committee came to consider the Bill, they found a number of things cropping up, which certain members were pressing for inclusion in the measure; and as there was not time to consider them all, it was resolved to drop the Bill.

The Arbroath Gas Corporation have accepted the offer of Messrs. Pettigrew and Co., of Middlesbrough, to erect the sulphate plant in their works, at a cost of £357. They have also resolved to abolish meter-rents.

With reference to the Arbroath water supply, the Police Commissioners on Monday night unanimously resolved to rescind the resolution of the last Commission to proceed with the introduction of a gravitation supply, and remitted to a Committee to consider the augmentation of the supply from the pumping-stations in the Nolt Loan.

It is not often that complaint is heard that the price of gas has been unduly reduced; yet this took place at a meeting—a rather hole-and-corner meeting, I should call it—in Arbroath on Wednesday. The persons who met are holders of bonds to the amount of £5000, which were granted them in respect of loans for harbour purposes. Part of the security under these bonds was gas profits to an extent not

exceeding £250 a year. The complaint now made is that the Corporation, in reducing the price of gas from the figure it stood at when the bonds were granted—namely, 5s. 8d.—to 4s. 2d. per 1000 cubic feet, have prevented a surplus being earned on the gas supply. The Chairman of this meeting, which, all told, numbered eight gentlemen, indulged in some heated fulminations against the accounts of the Gas Corporation; and was understood to mean that the accounts might have been prepared so as to bring out surpluses from which harbour interest might have been paid. A Committee was appointed to lay the matter before the Town Council. I hope they will get snubbed. It would be worse to take gas profits to pay interest on harbour loans than it would be to take harbour profits to assist the gas undertaking, did it require help. If the bondholders accepted a nebulous security like that they hold, that is their look-out; but gas consumers ought not to be made to suffer in order that they might get their interest. Let that be paid out of the rates; in which case it will fall equally upon all.

Sulphate of ammonia is reported to be selling in Scotland this week at £8 15s. per ton for spot delivery, which is a shade firmer.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Nov.* 16.

Sulphate of Ammonia.—Early in the week, the market was very quiet at a slight decline; but within the past few days, there has been more inquiry; and it looks as though the operators were being obliged to come in to cover their November sales. So far, they are moving very cautiously; but everything offering at the lowest points has been picked up, and in some quarters an advance has been realized. The closing value is about £8 15s. f.o.b. at the ports. For forward delivery, the situation is practically unchanged; for, although buyers seem more disposed to operate, sellers remain firm, and not much business has therefore been done.

Nitrate of Soda is quiet at 7s. 9d. per cwt. on spot. The forward position is unchanged.

LONDON, *Nov.* 16.

Tar Products.—A sharp advance has taken place in the benzol series. There is no doubt now that the benzol going into consumption for enriching gas has relieved the market of any surplus existing before. There are pressing inquiries in every direction; and it would appear that benzols will yet see higher prices. Pitch is somewhat languid at former rates. But most makers are fully sold; and heavy shipments are being made. Price tends towards easier rates for next year's delivery. Carbolic acid is in fair request; and old stocks having been cleared out, it is reported that makers are shorter of this article, in any of its forms, than has been the case for many years. Anthracene is reported firmer on the Continent; and for good brands there is a distinctly improved inquiry. Solvent naphtha has participated in the improvement in benzols; and the market for naphthalene salts is steady. The values obtainable during the week are: Tar, 19s. to 23s. 6d. Pitch, 35s., west coast; 38s., east coast. Benzols, 90's and 50's, 1s. 6d. Solvent naphtha, 1s. 3½d. Toluol, 1s. 6½d. Crude, 30 per cent., naphtha, 5½d. Naphthalene salts, pressed, 50s.; drained, 27s. Cresylic acid, distilled, 1s. 2d.; crude, 9d. Carbolic acid, 60's, 1s. 8d.; 75's, 2s. 0½d. Anthracene, "A," 1s.; "B," 9½d.

Sulphate of Ammonia appears hopelessly to be in the hands of operators and dealers; and, although considerable shipments are taking place, and stocks are largely reduced, there seems to be no recuperative life in the article, although important business has been done at London, £9; Hull, £8 15s.; Newcastle, £8 15s.; Leith, £8 13s. 9d.; Liverpool, £8 17s. 6d.; Glasgow, £9—all less 3½ per cent., delivered f.o.b., bags included. For forward delivery, an advance of 5s. to 10s. is asked. Gas liquor is quoted at 7s. to 8s.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—In the coal trade here business has again quieted down. Very few pits are working full time; while in most cases where advances were attempted on list rates with the commencement of the month, these have had to be abandoned. The only real upward move is where prices which were previously exceptionally low have been pulled up to list rates. For house coals the demand, which recently briskened up owing to the colder weather, has now fallen to only moderate dimensions. Prices still average about 10s. 6d. per ton at the pit for best Wigan Arley; 9s. to 9s. 6d., for Pemberton four-feet and seconds Arley; and 7s. to 7s. 6d., for common house-fire qualities. The inferior descriptions of round coal, which did not appreciably participate in the spurt of activity with the commencement of the month, are in very slow demand; and with a continued excess of supplies over requirements, prices necessarily are kept at a very low point. Good descriptions of steam and forge coals do not average more than 6s. to 6s. 6d. per ton at the pit mouth; whilst in the shipping trade, which continues very depressed, ordinary descriptions of steam coal are obtainable at 7s. to 7s. 6d. per ton delivered at Mersey ports, or 7s. 3d. to 7s. 9d. delivered at the Partington tips on the Manchester Ship Canal. With regard to engine classes of fuel, medium qualities still move off fairly well at about late rates; but inferior descriptions hang on the market, with concessions on quoted rates offered to effect clearance sales. Average quoted rates remain at about 3s. to 3s. 6d. per ton at the pit mouth for common, to 4s. 6d. and 5s. for best sorts.

Northern Coal Trade.—There has been some interruption to the working of most of the collieries, owing both to the lack of orders for steam coal, and also to the delay of steamers through the stormy weather; so that the work has for the last week been very scanty at many of the Northumbrian collieries. At the Durham pits, there has been an occasional stoppage through the non-arrival of steamers; but most of the gas-coal pits have now full work, and there may be even pressure to obtain full supplies before a month is over. Best Northumbrian steam coals are still quoted at 8s. per ton f.o.b.; but sales at lower prices have taken place, and the want of work at some pits weakens the rate. Second-class steam coals are 7s. 6d. per ton f.o.b. generally; and steam smalls are about 4s. per ton. Tenders have been taken this week for the large contracts for the locomotive coal for the North-Eastern Railway; but it is probable that they will not be decided on for a fortnight, and in the end the price to be paid will be much lower than that under the contracts that are now running. The extreme dulness in the steam coal trade will make locomotive coal cheap. In household coal the demand is increasing; but there is an abundant supply. For shipment, the quotation for this class of coal varies from 10s. to 11s. per ton f.o.b. Gas coals are now in very strong demand; and for about three weeks there will be very strong pressure to obtain adequate supplies for the winter season. The quotation for best Durham gas coals for odd cargoes is now from 6s. 9d. to 5s. 3d. per ton f.o.b.; but most of the pits have very little coal to spare after meeting the large deliveries on contracts of long standing. Manufacturing coal is steady; and contracts that are being renewed for another year are generally at the prices that have ruled this year, so that this branch of the trade seems better than the steam coal trade in prospect. Coke is steady at from 14s. 6d. to 15s. per ton f.o.b.; but the exports are rather lower than they were, though the home consumption is still very heavy, and likely so to continue. Gas coke is rather fuller in production, but is well taken up both for export and locally; and there is no alteration of moment in the price this week.

Scotch Coal Trade.—Trade in Scotland is neither better nor worse. The shipbuilding dispute on the Clyde is doubtless interfering a good deal with it; but there is, notwithstanding, a good volume of trade, though rates do not improve. The prices quoted are: Main, 5s. 9d. to 6s. per ton f.o.b. Glasgow; ell, 6s. 9d. to 7s.; splint, 6s. 3d. to 6s. 6d.; and steam, 7s. 6d. to 7s. 9d. The shipments for the week amounted to 161,766 tons—a decrease as compared with the preceding week of 2368 tons, but an increase over the corresponding week of last year of 10,969 tons. For the year to date, the total shipments have amounted to 6,428,798 tons—an increase on the corresponding period of last year of 2,070,819 tons, but a decrease as compared with 1893 of 38,365 tons.

Sales of Shares.—A few fully-paid 6 per cent. preference shares (£12 10s. each) in the *Salisbury Gas Company* have recently been sold by auction at £18 7s. 6d. and £18 10s.——At the Mart, Tokenhouse Yard, last Wednesday, £50 of 6 per cent. second mortgage debentures of the *Cape Town and District Gas Company* were sold for £53 10s.——At the Sun Hotel, Shipley, last Thursday, Mr. W. Booth sold by auction £4000 of new ordinary 7 per cent. stock of the *Shipley Gas Company*, at prices ranging between £168 and £171 per £100 of stock.——About 100 shares in the *Bournemouth Gas and Water Company* have recently changed hands at £29 10s. per share for £10 original shares, £17 15s. each for "B" shares, and £18 15s. each for 6 per cent. preference shares.

The Explosion in the Strand.—The inquiry into the circumstances attending the death of Fireman Sprague through injuries caused by the fall of buildings in New Church Court, Strand, on the 29th ult., subsequent to an explosion, was resumed yesterday. Evidence was given on behalf of the New River Company and The Gaslight and Coke Company; among the principal witnesses for the latter being Sir Frederick Bramwell and Mr. G. F. L. Foulger. At the close of the evidence, the Coroner, (Mr. John Troutbeck), in directing the jury, exonerated from culpable negligence all parties interested; and the jury simply returned a verdict of "Accidental death." A report of the evidence touching upon the cause of the explosion will be published next week.

The West Kent Boards and the London Water Bills.—The presentation of the proportionate costs incurred by the various local authorities in West Kent in opposing the Water Bills of the London County Council is causing some friction; several of the Boards objecting to pay anything. At the meeting of the Bexley Urban District Council last Thursday, application was made for the payment of £52 16s. 6d., the sum apportioned to that district. Mr. Cottell proposed that, as the Council had not by resolution agreed to incur any liability, payment be declined. Mr. Pitt seconded the proposition. Mr. Lucas thought this would be exceedingly shabby, and might also prove foolish; for, should they refuse to pay their share, in the event of a Joint Water Trust being formed, they would probably find Bexley excluded from the advantages. It was decided that further inquiries should be made.

The London Vestries and the Water Supply.—At the last fortnightly meeting of the Bermondsey Vestry, presided over by Mr. A. Pomeroy, the Finance Committee reported that an account had been sent in to the Southwark and Vauxhall Water Company, amounting to £144 18s., for supplying the inhabitants of the parish with water during the severe frost of last winter. The Company had written stating that they could not accept or recognize any liability or responsibility whatever in the matter. Mr. Ball said he was not sure that the Vestry had any real claim on the Company; but the Committee were strongly of opinion that the money should be paid. If the Company persisted in their refusal to pay, he believed the Vestry had no power to force them to do so. He moved the adoption of the report. Mr. Maule seconded the motion, and said the Lambeth Water Company had reimbursed the Vestry in a similar case; and he thought the Southwark and Vauxhall Company should be made to do the same. The Vestry ought also to express their opinion of their sense of the injustice of the matter. The report was adopted; and it was decided to send two of the officials of the Vestry to see if they could come to any settlement with the Company. The General Purposes Committee reported the receipt of a letter from the Lambeth Water Company asking if the Vestry would be prepared to assist them in supplying householders with water by means of water-carts in the event of a severe frost; and inquiring what the charge would be per day, including a horse and two men. The Committee advised that the Company should be informed that the Vestry was prepared to do so. This was agreed to; and it was also decided that a communication should be sent to the Southwark and Vauxhall Water Company stating that the Vestry were also prepared to supply them in a similar manner.

Reduction in Price.—The Directors of the Brighton and Hove Gas Company have decided to reduce the price of gas 2d. per 1000 cubic feet as from Jan. 1 next.

The Burnley Corporation and Prepayment Gas-Meters.—The Gas Committee of the Burnley Corporation have decided to apply to the Local Government Board for power to borrow £5000, the greater portion of which sum is for the purchase of prepayment meters. A larger number of the poorer class of the inhabitants within the area of supply have shown a disposition to avail themselves of this system of obtaining gas.

Rejection of the Sheffield Water Scheme by the Barnsley Corporation.—The Town Clerk of Barnsley reported to the Town Council last Saturday week that the letter which had been received from the Sheffield Corporation respecting the Barnsley Water Bill (*ante*, p. 936) had been before an informal meeting of the Council; and it was unanimously directed that the following reply should be sent: "Your letter of the 24th ult. has been duly considered by the Barnsley Town Council; and they desire me to express their surprise that the letter has been made public before it was possible to lay it before them. In the opinion of the Council, your letter does not disclose any grounds of objection to the Barnsley Water Bill which were not urged on behalf of the Sheffield Corporation when the Bill was before the Committee of the House of Lords, by whom it was approved. The Council are unable to accede to the proposals contained in your communication, and they therefore instruct me to inform you that it is their intention to proceed in the next session of Parliament with the Bill, which they believe, but for the dissolution of Parliament, would have become law."

Cost of Works for Safeguarding and Filtering the Water Supply of Bolton.—During the recent municipal election campaign at Bolton, Mr. Lythgoe (one of the candidates) ventured to assert at a public meeting "that the rates were being kept down at the expense of the public health." This charge was characterized by Alderman J. Miles, also at a public meeting, as a "base and calumnious one;" and he has since supported his words in a letter to the local press. In this, he deals mainly with the work of the Water Committee, in order to show what they have done to render the water supply as pure as possible. He says that since 1879, no less a sum than £77,409 has been spent by the department to this end; the following being the work executed, and the cost: Heaton watershed—enclosing streams in earthenware pipes, stone drains, &c., £2647; Heaton filter-beds, £7794 4s.; Sweetloves filter-beds, £39,857 4s. 9d.; Egerton filter-beds, £611 3s. 2d. Entwistle watershed—enclosing streams in earthenware pipes, stone drains, &c., £3000. Entwistle reservoir—stone breaching slopes, &c., £20,000. Dingle reservoir—removing dirt from inside, £3500. Alderman Miles also mentions that, since 1875, the sum of £154,820 has been transferred from the profits of the department to the relief of the borough rate. He has authority for saying that the water supplied in the district at the present time is as good, wholesome, and pure as any water gathered and supplied in Lancashire.

Proposal to Acquire the Deal and Walmer Water-Works by Local Authorities.—The Walmer District Council have been discussing the question of the purchase of the local Water Company's property; and the Deal Town Council will be invited by one of their number to consider the matter at their next meeting. The member who introduced the subject at the meeting of the Walmer authority was Mr. T. Denne, who, having stated that the public had suffered great inconvenience from want of a proper supply of water, advocated the desirability of coming to an arrangement with the Deal Town Council to purchase the concern. He showed that it was a profitable undertaking, by declaring that the Company were paying a 10 per cent. dividend. Quoting several figures, he worked out the present capital value as £46,715; and compensation and other expenses ran up the total estimate to about £50,000. The actual capital subscribed was £28,000; so that he thought it would be a fair bargain. The income from rentals on the rateable value was £2560; from meters, &c., £890; and from rents and sales, £20—making a total of £3470. The expenses Mr. Denne calculated at £2750. There would thus be a balance of £720; and he thought they would get even more profit than this, if the concern were properly managed. It was agreed that a Committee should be appointed to confer with the Deal Town Council as to the desirability of the supply being taken over by the two authorities; and five gentlemen were afterwards selected.

Purchase of the Shoreham Water-Works by the Brighton Corporation.—At a special meeting held on the 7th inst., the Brighton Corporation decided to acquire the undertaking of the Shoreham Water Company. The terms of purchase are as follows: A sum of money which, if invested in Consols at the market price current on the day of the date of the agreement, will produce an income of £1304 per annum (that being the total amount of the yearly interest payable on the Company's called-up share capital), and the following several sums in addition—viz., the sum of £4875, being the par value of the debenture capital; the sum of £1000, being the amount of the reserve fund; the sum of £500 to be divided among the Directors in settlement of their fees; and the sum of £5300, being for and in respect of back unpaid dividends and prospective value. The Company will be prepared to accept, in lieu of the first item, sufficient Brighton Corporation stock to produce the yearly income of £1304. The amount of such stock to be given would be £47,250; representing, at a quotation of £120, a cash equivalent of £56,700. The Corporation will include, in a Bill they intend to promote next session, an application for power to raise £100,000 to cover the cost of the purchase of the undertaking and of any additional works that may be necessary in connection therewith. We learn from a local correspondent that the decision of the Corporation has come with some surprise to the other governing bodies of the neighbourhood; for a Committee was appointed some time ago by the New Shoreham Urban District Council and the Steyning East and West District Councils, with a view to purchasing the undertaking. But they have been so long in getting to work that they find the ground cut from under their feet; and now they threaten opposition to the Corporation's Bill.

Fletcher, Russell, and Co., Limited.—The fourth annual meeting of this Company was held at their showrooms, No. 30, King Street, Manchester, on Monday last week. The trading account presented showed a gross profit of £23,822, after writing off depreciation. Deducting the Managing Directors' and Directors' salaries, interest on debentures, premiums on debenture redemptions, the interim and final dividends paid on the preference shares at the rate of 6 per cent. per annum, and the interim dividend paid on the ordinary shares, at the rate of 7½ per cent. per annum, the balance remaining for disposal amounted to £13,367. The Directors recommended that £4000 should be further written off the property accounts; £5492 be added to the reserve fund, which will make this fund £9786; and use the remainder in the payment of a dividend at the rate of 12½ per cent. per annum on the ordinary shares—making, with the interim dividend paid, 10 per cent. for the year. A vote of thanks was passed to the Directors for the satisfactory results of the year's working and the reports laid before the shareholders.

The West Bromwich Gas Undertaking.—At a complimentary banquet given to the retiring Mayor in the West Bromwich Town Hall, on Monday evening last week, Alderman R. Farley, the Chairman of the Gas Committee, gave some interesting particulars relative to the Corporation gas undertaking since it was acquired by the Town from the Birmingham Corporation, nearly sixteen years ago. He said the gas undertaking was transferred to the West Bromwich Corporation in 1880; and since that time, though they had kept the price of gas low, they had applied out of the profits on the gas-works £17,640 in relief of the rates, they had placed to the depreciation fund £4000, £9980 had been set aside out of the profits for working capital, and £22,400 to the sinking fund; and yet the gas undertaking had not cost the ratepayers of West Bromwich one farthing. He thought this was a result of which they might well be proud. When the loan capital was paid off, the works would, he believed, produce large sums in aid of the rates of the borough. There were in West Bromwich at the present time 930 street-lamps, which was double the number in existence fifteen years ago; and they were expending out of the rates £1000 a year more in public lighting. The newly-elected Mayor (Mr. G. Salter) and others spoke in complimentary terms of Alderman Farley's services to the borough, especially in connection with the gas undertaking.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 1018.)

Issue.	Share	When ex-Dividend.	Dividend or Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.				£ s. d.
590,000	10	16 Oct.	10½	Alliance & Dublin 10 p. c.	10	22½–23½	+½	4 9 5
100,000	10	,,	7½	Do. 7 p. c.	10	16½–17½	..	4 5 8
300,000	100	1 July	5	Australian (Sydney) 5 % Deb.	100	107–109	..	4 11 9
200,000	5	14 Nov.	6½	Bombay, Limited	5	7–7⅛	..	4 6 8
40,000	5	,,	6½	Do. New	4	5–5⅛	..	4 14 7
380,000	Stck.	14 Aug.	12	Brentford Consolidated	100	253–258	..	4 13 0
180,000	,,	,,	9	Do. New	100	205–210	..	4 5 8
220,000	Stck.	27 Sept.	11	Brighton & Hove Original	100	227–232	..	4 14 10
933,500	Stck.	29 Aug.	5	Bristol	100	125–130	..	3 16 11
320,000	20	27 Sept.	11½	British	20	54⅛–55½	..	4 1 1
50,000	10	29 Aug.	11½	Bromley, Ordinary 10 p. c.	10	22½–23½	..	4 17 10
51,510	10	,,	8½	Do. 7 p. c.	10	18½–19½	..	4 7 2
328,750	10	14 Nov.	4	Buenos Ayres (New) Limited	10	8–8⅛*	..	4 14 1
200,000	100	1 July	6	Do. 6 p. c. Deb.	100	102–104	..	5 15 5
150,000	20	11 July	8½	Cagliari, Limited	20	31–33	..	5 0 0
550,000	Stck.	26 Oct.	13⅜	Commercial, Old Stock	100	320–325	..	4 3 1
165,000	,,	,,	10½	Do. New do.	100	247–252	..	4 3 4
160,762	,,	12 June	4½	Do. 4½ p. c. Deb. do.	100	143–147	..	3 1 3
800,000	Stck.	12 June	13	Continental Union, Limited.	100	278–283	..	4 11 10
200,000	,,	,,	10	Do. 7 p. c. Pref.	100	215–220	..	4 11 10
535,000	Stck.	29 Aug.	5½	Crystal Palace Ord. 5 p. c. Stk	100	125–130	..	4 0 9
486,090	10	26 July	11	European, Limited	10	25½–26½	..	4 3 0
354,060	10	,,	11	Do. Partly paid	7½	17–18	..	4 14 3
5,646,590	Stck.	14 Aug.	12¾	Gaslight & Coke, A, Ordinary	100	292–297	..	4 5 10
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	107–112	..	3 11 5
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	284–288	+1½	3 9 5
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	135–140	..	3 11 5
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	200–205	..	3 13 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	100	193–198	..	3 10 9
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	282–287	..	3 9 8
476,000	,,	,,	6	Do. K, 6 p. c. Prf..	100	167–170	..	3 10 7
1,061,150	,,	12 June	4	Do. 4 p. c. Deb. Stk.	100	135–140	..	2 17 2
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	147–152	..	2 19 2
908,000	,,	,,	6	Do. 6 p. c. do.	100	202–207	..	2 17 11
3,800,000	Stck.	14 Nov.	12	Imperial Continental	100	237–242*	−2	4 19 2
75,000	5	26 June	6	Malta & Mediterranean, Ltd.	5	6–6⅛	..	4 12 4
560,000	100	1 Oct.	5	Met.of Melbourne, 5 p.c. Deb.	100	113–116	..	4 6 2
541,920	20	14 Nov.	5	Monte Video, Limited	20	17–18*	−½	5 11 2
150,000	5	24 May	8	Oriental, Limited	5	7⅛–8	..	5 0 0
60,000	5	12 Sept.	7	Ottoman, Limited	5	5–5⅛	..	6 7 3
166,870	10	14 Feb.	2	Para, Limited	10	1⅛–2⅛	..	8 0 0
				People's Gas of Chicago—				
420,000	100	2 Nov.	6	1st Mtg. Bds.	100	105–110	..	5 9 1
500,000	100	4 June	6	2nd Do.	100	102–107	..	5 12 1
150,000	10	16 Oct.	7	San Paulo, Limited	10	11–12	..	5 16 8
500,000	Stck.	29 Aug.	15½	South Metropolitan, A Stock	100	370–375	..	4 2 8
1,350,000	,,	,,	12	Do. B do.	100	308–313	..	3 16 8
308,685	,,	,,	13	Do. C do.	100	325–330	..	3 18 9
800,000	,,	11 July	5	Do. 5 p. c. Deb. Stk.	100	175–178	..	2 16 2
60,000	Stck.	12 Sept.	11½	Tottenham & Edm'nton, "A"	100	230–235	..	4 17 10
				WATER COMPANIES.				
746,021	Stck.	26 June	10	Chelsea, Ordinary	100	295–300	+1	3 6 8
1,719,514	Stck.	16 Oct.	7	East London, Ordinary	100	220–225	−3	3 2 2
654,740	,,	26 June	4½	Do. 4½ p. c. Deb. Stk.	100	157–162	..	2 15 6
700,000	50	26 June	7	Grand Junction	50	118–122	..	2 17 5
708,000	Stck.	29 Aug.	12	Kent	100	307–312	..	3 16 11
1,043,800	100	26 June	7½	Lambeth, 10 p. c. max.	100	249–254	−1	2 19 4
406,200	100	,,	7½	Do. 7½ p. c. max.	100	208–213	..	3 10 5
330,000	Stck.	27 Sept.	4	Do. 4 p. c. Deb. Stk.	100	143–148	..	2 13 4
500,000	100	14 Aug.	12⅝	New River, New Shares	100	380–390	−5	3 3 7
1,000,000	Stck.	26 July	4	Do. 4 p. c. Deb. Stk.	100	143–148	..	2 14 2
902,300	Stck.	12 June	4	S'thwk & V'xhall, 10 p.c. max.	100	146–151	..	2 12 11
126,500	100	,,	4	Do. D 7½ p.c. do.	100	140–145	..	2 15 2
1,155,066	Stck.	12 June	10	West Middlesex	100	293–298	..	3 7 1

*Ex div

GWYNNE & BEALE'S
PATENT GAS EXHAUSTERS AND ENGINES.

Telegrams: "GWYNNEGRAM, LONDON." Telephone No. 65,095.

GWYNNE & CO.,
HYDRAULIC AND GAS ENGINEERS,
BROOKE STREET WORKS, HOLBORN, LONDON, E.C.

Late ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON.

They have completed Exhausters to the extent of 32,000,000 cubic feet passed per hour, which are giving unqualified satisfaction in work.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS, PATENT RETORT-LIDS, STEAM-PUMPS for Tar, Liquor, or Water; CENTRIFUGAL PUMPS and PUMPING ENGINES, specially adapted for Water-Works, raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

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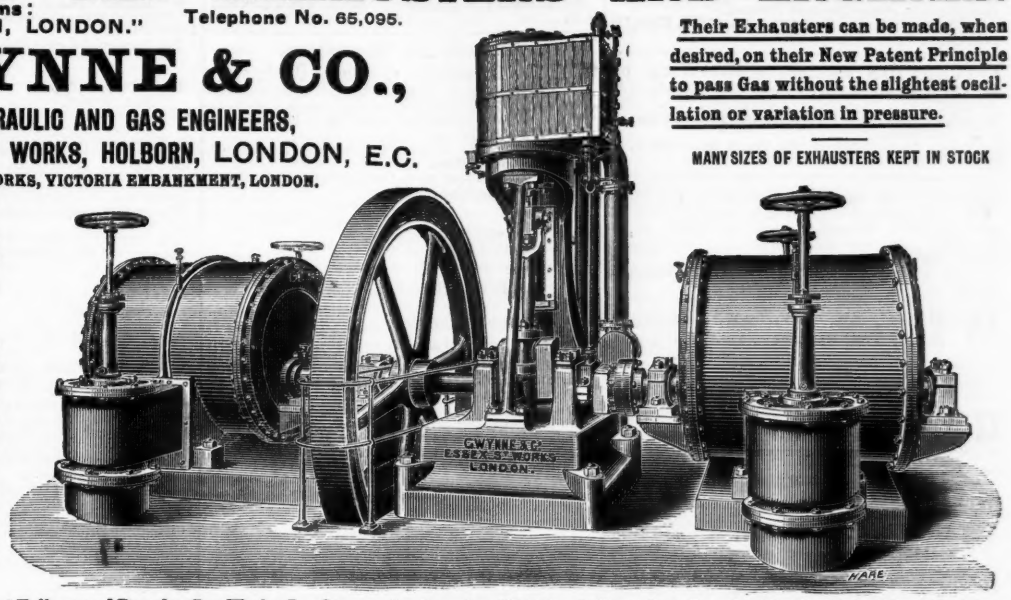

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Catalogues and Testimonials sent on application.

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Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS, should be received not later than the FIRST POST on SATURDAY.

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O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides combined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.

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WINKELMANN'S "VOLCANIC" CEMENT. Fire Resistance up to 4500° Fahr. In use in most Continental Gas-Works, and in more than 300 British Gas-Works

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BROTHERTON AND Co., Chemical Manufacturers. Works: BIRMINGHAM, LEEDS, and WAKEFIELD.

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GOLD MEDAL, 1892.

TUBES and Fittings for Gas, Steam, and Water, in stock to 8 inches diameter; Iron and Steel Ascension-Pipes.
JOHN SPENCER, Globe Tube Works, WEDNESBURY; and 14, Great St. Thomas Apostle, LONDON.

HUTCHINSON BROTHERS, Gas Engineers, &c., Falcon Works, Barnsley, Makers of Wet and Dry Gas-Meters, Brass-Work, and general Gas Apparatus, Lead Saturators, Tanks, &c., Tools, and Gas-Works Sundries. (See p. II., centre of last issue.)
Telegrams: "HUTCHINSON BROS., BARNSLEY."

BACK-PRESSURE IN PURIFIERS.

THE Valve invented by Mr. Cripps for Bye-Passing any Layer of Purifying Material (referred to by the President of the Incorporated Institution of Gas Engineers in his Inaugural Address) can be obtained of the Makers: C. & W. WALKER, Midland Iron-Works, Donnington, near Newport, SALOP, and J. EVERY & SON, Phœnix Iron-Works, LEWES, to which Firms all inquiries should be addressed.

W. C. HOLMES & CO., Huddersfield; AND 80, CANNON STREET, LONDON, Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also Improved Patent Rotary Scrubber-Washers.
*** See Advertisement p. II., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
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JOHN NICHOLSON & SONS, Limited, Chemical Works, Leeds, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

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For all Joints in connection with Oil-Gas Plant and Sulphate Plant.
For all Gas Joints.
For all Tar Joints.
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BALE & CO.'S Oxide of uniform quality.
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FINEST Quality of Natural Bog Ore.
Particulars and price, apply to Mr. T. L. ARCHER, 20, Fennel Street, MANCHESTER.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors for the erection of Gas-Works for, Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
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HYDRATED OXIDE OF IRON.

PREPARED from pure Iron.
Two or three times as rich as Bog Ore.
Strong action on Sulphuretted Hydrogen.
To be used alone, but will increase activity of other Oxides.
Less than half the price of Bog Ore.
Can be lent on hire.
Write for tabulated results.
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DESTRUCTIVE DISTILLATION: A Manualette of the Paraffin, Coal Tar, Rosin Oil, and kindred Industries. By PROFESSOR E. J MILLS, D.Sc., F.R.S. *Imp.* 8vo., 5*s.*
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TO GAS AND WATER COMPANIES.

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Apply, by letter, to No. 2594, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

SITUATION wanted, in Gas-Works or otherwise, as SULPHATE of AMMONIA MAKER or STOKER. Thoroughly understands Rectifying Naphtha. Certificated for Engine Driving. Fair Fitter. Good References.
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WANTED, by a Married Man, a Situation as MANAGER in Small Works or SMITH and FITTER. Fourteen years' Experience in all Branches. Six years in last Situation. Good References; Abstainer.
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WANTED, an experienced Sulphate Maker. State Experience, Age, and Wages.
J. CHEW,
Engineer.
Gas-Works, Blackpool.

GAS Stoker wanted, day work. Seven Retorts in Winter, and Three in Summer. Married Man preferred; 25s. per week. References required.
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WANTED, immediately, a Working MANAGER for the Bryncelyn Gas-Works, Pontardawe, near Swansea. He must be a good Fitter, and capable of fitting up Houses throughout. Help given when required. Wages, 30s. per week inclusive.
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WANTED, a Young Man as Assistant FITTER or IMPROVER. Must be used to Iron and Compo. work, and able to read Meters correctly.
Address, stating Age, &c., and enclosing References, No. 2599, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a thoroughly practical GAS-FITTER, capable of Testing and Fixing Wet Meters, fitting Gas-Fires, Gas-Engines, and Gas Cooking-Stoves, well up in Iron and Compo. Work, &c. Wages, 8d. per hour. Constant employment to a suitable Man.
Application to be made, in first instance by letter only, with *copies* of Testimonials (which will not be returned) enclosed, to Mr. W. H. WAYTE, Outdoor Superintendent, Borough Gas-Works, WEST BROMWICH.

SINGAPORE GAS COMPANY, LIMITED.

WANTED, a fully qualified Gas Engineer to take over the duties of MANAGER and LOCAL SECRETARY of the above Company in March next (leaving England about the 1st of February). Salary, $400 a month, with good Residence and other Allowances, including First-Class Passage for himself and wife. Three years' engagement.
Applications, stating Age (which must be under 40), Qualifications, together with not more than three recent Testimonials, should be forwarded by Wednesday, the 11th of December, to the undersigned, from whom all particulars can be obtained.
ROBERT M. CHRISTIE,
Secretary.
98, Cannon Street, E.C.

WANTED, to purchase, second-hand TANK mounted on Wheels. Capacity about 420 Gallons. Suitable for hauling Tar to Railway Station.
Price and Particulars to
PHILIP THOMAS.
Gas-Works, Wellington,
Somerset, Nov. 14, 1895.

TOWN OF HOVE, SUSSEX.

THE Urban District Council have for SALE a 400-light WET METER in Cast-Iron Case. Makers: Wright & Co., Westminster.
Can be seen upon application to the TOWN CLERK, Town Hall, HOVE.

MATLOCK BATH GASLIGHT AND COKE COMPANY, LIMITED.

FOR SALE—5000 feet (per hour) Waller Three-Blade EXHAUSTER, in thorough working order. Can be seen at the Works.
Offers to A. W. Elton, Manager.
By order,
ARTHUR CLARK,
Secretary.

GAS PLANT FOR SALE.

THE Corporation of Walsall have for SALE a Set of four PURIFIERS, 10 feet square and 4 feet deep, with Hydraulic Centre-Valve and Connections all complete.
Also a 20,000 feet per hour STATION METER, with Connections all complete.
May be seen at the Wolverhampton Street Works, Walsall.
Any further Particulars may be obtained from
J. TINDALL,
Engineer.
Nov. 8, 1895.

FOR SALE—Second-hand 100-light Gas- METER (George Glover & Co.). Requires regulating.
ST. GEORGE'S WORKHOUSE, Wallis's Yard, LONDON, S.W.

RETORTS AND FIRE-BRICKS.

THE Directors of the Rochester, Chatham, and Strood Gaslight Company are prepared to receive TENDERS for the supply of about 1400 feet run of FIRE-CLAY RETORTS, 43,000 FIRE-BRICKS, 50 TILES, and 60 Tons of CLAY.
Specification and Form of Tender may be obtained from the undersigned, to whom tenders, endorsed "Tenders, &c.," must be delivered on or before Noon, of Thursday, the 5th of December, 1895.
J. M. VEEVERS,
Engineer and Secretary.
Gas Offices: 95, High Street,
Rochester, Nov. 7, 1895.

BASINGSTOKE GAS COMPANY.

TO CONTRACTORS AND OTHERS.

THE Basingstoke Gas Company invite TENDERS for the excavation and construction of a BRICK and PUDDLE GASHOLDER TANK.
Drawings and Specifications can be seen on application to the Company's Engineer, and copies obtained on payment of Ten Shillings, which, however, will be returned on the receipt of a *bonâ-fide* Tender.
Sealed tenders must be sent in on or before Saturday, Dec. 7, 1895, endorsed "Tender for Gasholder Tank."
The Directors do not bind themselves to accept the lowest or any tender.
WILLIAM HIGGS,
Engineer and Manager.

SHEFFIELD UNITED GASLIGHT COMPANY.

NEEPSEND STATION.
No. 2 RETORT-HOUSE.

TO ENGINEERS, IRONFOUNDERS, ETC.

THE Directors of this Company invite TENDERS for the Manufacture and Delivery, without Erection, of RETORT-FITTINGS for 96 Retorts, also PLATES and GIRDERS for Stage-Floor for No. 2 Retort-House at their Neepsend Station.
Drawings may be seen, and Bill of Quantities with Specification and Form of Tender obtained, on application to the Engineer, Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.
Sealed tenders, endorsed "Tender for Retort-Fittings," to be delivered by post to the undersigned, at the Company's Offices, on or before Saturday, the 30th day of November.
The Directors do not bind themselves to accept the lowest or any tender.
HANBURY THOMAS,
General Manager.
Commercial Street, Sheffield,
Nov. 2, 1895.

SHEFFIELD UNITED GASLIGHT COMPANY.

NEEPSEND STATION.
No. 4 PURIFYING-HOUSE.

TO ENGINEERS, IRONFOUNDERS, ETC.

THE Directors of this Company invite TENDERS for the supply and erection of Four PURIFIERS, 42 ft. by 21 ft., together with Covers, Lifting Apparatus, Valve, and Connections, and also CAST-IRON GIRDERS and COLUMNS to form FLOOR for carrying the same for No. 4 Purifying-House at their Neepsend Station.
Drawings and Specification may be seen, and Bill of Quantities with Form of Tender obtained, on application to the Engineer, Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.
Sealed tenders, endorsed "Tender for Purifiers," to be delivered by post to the undersigned, at the Company's Offices, on or before Saturday, the 30th day of November.
The Directors do not bind themselves to accept the lowest or any tender.
HANBURY THOMAS,
General Manager.
Commercial Street, Sheffield,
Nov. 2, 1895.

SHEFFIELD UNITED GASLIGHT COMPANY.

NEEPSEND STATION.
No. 4 PURIFYING-HOUSE.

TO STEEL JOIST MANUFACTURERS, CONTRACTORS, ETC.

THE Directors of this Company invite TENDERS for the Manufacture and Delivery, without Erection, of a ROLLED STEEL GIRDER FLOOR, 99 ft. 3 in. long, by 65 ft. 3 in. wide, for their No. 4 Purifying-House at their Neepsend Station.
Drawings may be seen, and copy of Specification with Bill of Quantities and Form of Tender obtained, upon application to the Engineer, Mr. Fletcher W. Stevenson, on payment of 10s. 6d., which will be returned on receipt of *bonâ-fide* tender.
Sealed tenders, endorsed "Tender for Oxide-Floor Girders," to be delivered by post to the undersigned, at the Company's Offices, on or before Saturday, the 30th day of November.
The Directors do not bind themselves to accept the lowest or any tender.
HANBURY THOMAS,
General Manager.
Commercial Street, Sheffield,
Nov. 2, 1895.

URBAN DISTRICT COUNCIL OF PADIHAM.
(GAS DEPARTMENT.)

THE Gas Committee of the above District Council invite TENDERS for a supply of about 700 yards of 4-inch Turned and Bored CAST-IRON PIPES.
For Particulars, apply to
J. R. SMITH,
Gas Manager.
Gas Offices, Padiham,
Nov. 16, 1895.

CORPORATION OF BLACKPOOL.

TENDERS wanted for the making and delivery of 718 lineal feet of 4-inch WROUGHT-IRON or STEEL MAINS, 24 inches diameter, and about 2 tons of SPECIAL CASTINGS for same.
Particulars may be had at the Office of the undersigned.
Tenders to be sent to the Chairman of the Gas Committee by the 23rd of November, at the Gas Offices.
(Signed) JOHN CHEW,
Engineer.
Gas Office, Blackpool,
Nov. 18, 1895.

CORPORATION OF LEICESTER.

RETORTS AND FIRE-BRICKS.

THE Gas and Electric Lighting Com- mittee of the above Corporation are prepared to receive TENDERS for the supply and delivery of RETORTS and FIRE-BRICKS.
Specification, Quantities, and Form of Tender can be obtained from the Engineer.
Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Retorts, &c.," to be delivered at these Offices not later than Eleven o'clock a.m., on Saturday, Dec. 7, 1895.
The Committee do not bind themselves to accept the lowest or any tender.
ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.
Offices: Millstone Lane,
Leicester, Nov. 14, 1895

CORPORATION OF LEICESTER.

CAST-IRON PIPE CONTRACT.

THE Gas and Electric Lighting Com- mittee of the above Corporation are prepared to receive TENDERS for the supply and delivery of the necessary CAST-IRON PIPES and CONNECTIONS, from 2 inches to 24 inches in diameter, required during the Twelve Months ending the 31st of December, 1896.
Specification and Form of Tender to be obtained from the Engineer.
Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Cast-Iron Pipes, &c.," to be delivered at these Offices not later than Eleven o'clock a.m., on Saturday, Dec. 7, 1895.
The Committee do not bind themselves to accept the lowest or any tender.
ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.
Offices: Millstone Lane,
Leicester, Nov. 14, 1895.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.

TO IRONFOUNDERS AND OTHERS.

THE Gas Committee are prepared to receive TENDERS for a supply of about 4000 yards of 3-INCH CAST-IRON MAINS, weight not to exceed 34 lbs.; about 2000 yards of 4-INCH CAST-IRON MAINS, weight not to exceed 46 lbs.; and for IRREGULARS, delivered free on Rails at Stockport.
Tenders, endorsed "Mains," must be addressed to the Chairman of the Gas Committee, Stockport, and sent in on or before Four p.m., on Monday, Nov. 25 next ensuing.
Full Particulars can be obtained on application to the Engineer, Mr. S. Meunier.
No tender will be accepted without satisfactory proof that the firm tendering pays the standard rate of wages, and observes the standard number of hours.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
WALTER HYDE,
Town Clerk.
Nov. 15, 1895.

MANCHESTER CORPORATION GAS-WORKS.

CARBURETTED WATER-GAS INSTALLATION.

THE Gas Committee of the Corporation of Manchester are prepared to receive TENDERS for the various Works and Plant required in connection with the CARBURETTED WATER-GAS INSTALLATION at their Bradford Road Gas Station, as under, viz.—
CONTRACT No. 1.—FOUNDATIONS to BUILDINGS. Foundations and Basement to Extension of Purifier-House and erection of a Chimney-Shaft.
CONTRACT No. 2.—For the excavation and construction of a GASHOLDER TANK.
CONTRACT No. 3.—For the supply and erection of CAST-IRON PURIFIERS, WROUGHT-IRON GIRDERS, and CAST-IRON COLUMNS.
Drawings may be seen and General Conditions of Contract, Specifications, and Bills of Quantities obtained on application (in writing only) to Mr. C. Nicholson, Superintendent of the Gas Department, Town Hall. A deposit of One Guinea (which will be returned on receipt of a *bonâ-fide* tender) must accompany the application for a Form of Tender in respect of each Contract.
Sealed tenders, endorsed as above, and addressed to the Chairman of the Gas Committee, must be delivered at the Gas Offices, Town Hall, not later than Ten a.m., on Friday, the 29th inst.
The Corporation do not bind themselves to accept the lowest or any tender.
By order of the Gas Committee,
WM. HENRY TALBOT,
Town Clerk
Town Hall, Manchester,
Nov. 14, 1895.

TENDERS FOR PIPES.

THE Directors of the Broadstairs Gas Company are prepared to receive TENDERS for the supply of about 2700 yards of 10-inch CAST-IRON PIPE, also for SPECIALS, delivered at Broadstairs (L.C. & D.R.) Station, or in the Harbour, Broadstairs.

Sealed tenders to be addressed to the Chairman, and delivered to the Office of the Company, on or before Nov. 30 inst.

Further Particulars can be obtained of the undersigned.

W. J. LATCHFORD,
Secretary and Manager.

Gas Offices, Broadstairs,
Nov. 11, 1895.

CARDIFF GASLIGHT AND COKE COMPANY.
(INCORPORATED MAY 5, 1837.)

THE Directors of the Cardiff Gaslight and Coke Company Hereby Give Notice that they are prepared to receive not later than Ten a.m., Friday, the 13th of December, 1895, sealed TENDERS for

£15,000 "D" STOCK,

bearing a Maximum Dividend of 5 per cent. per annum, in pursuance of the powers of the Cardiff Gas Act, 1887.

Particulars and Conditions of Tender may be obtained on application to the undersigned.

By order,
GEORGE CLARRY,
Secretary.

Gas Offices, Cardiff,
Nov. 13, 1895.

By Order of the Directors—1500 £10 Shares in the West Ham Gas Company.

MR. ALFRED RICHARDS will Sell BY AUCTION, at the Mart, E.C., on Monday Nov. 25, at Two o'clock, in lots, 1500 £10 SHARES in the above Undertaking, to be issued under the Provisions of the West Ham Gas Act, 1889; the Dividends rising or falling at the same rate as on the Original Shares of £5 each. The last Dividend on the Company's £10 Shares was at the rate of 6½ per cent. per annum.

Particulars of the SECRETARY of the Company, at the Offices, STRATFORD; of F. E. HILLEARY, Esq., Solicitor, 5, FENCHURCH BUILDINGS, E.C.; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

BY ORDER OF THE DIRECTORS OF THE BARNET DISTRICT GAS & WATER COMPANY.

£820 of "D" Gas Capital Stock, being a further portion of the Gas Stock authorized to be raised by the Barnet District Gas and Water Act of 1883. The Maximum Dividend is 7 per cent.; the last Dividend paid on the same class of Stock having been at the rate of £6 6s. per cent. per annum.

MR. ALFRED RICHARDS will Sell the above BY AUCTION at the Mart, E.C., on Thursday, Dec. 5, at Two precisely, in lots.

Particulars at the place of Sale; of ALFRED LASS, Esq., Secretary of the Company, 30, GRACECHURCH STREET, E.C.; of C. A. BANNISTER, Esq., Solicitor, 70, BASINGHALL STREET, E.C.; and of the AUCTIONEER, 18, FINSBURY CIRCUS, E.C.

SOUTH SHIELDS GAS COMPANY.

IMPORTANT SALE OF GAS STOCK.

MR. M. STAINTON is instructed by the Gas Company to SELL BY PUBLIC AUCTION, in the Board-Room, at the Gas Offices, Chapter Row, South Shields, on Monday, the 2nd of December, 1895, at One o'clock p.m., prompt, £10,000 of NEW STOCK under the South Shields Gas Act, 1886.

The Stock will be put up in Lots of £100 each, nominal value. A Deposit of £10 per cent. to be paid on the purchase-money at the Sale; the remainder to be paid on or before the 31st of December next.

If the Purchaser pays the full amount at the time of Sale, he will be entitled to Interest thereon at the rate of 3 per cent. per annum, up to, and payable on, the 31st of December, 1895.

The Stock will be registered in the name of the Purchaser, free of expense.

By order of the Directors,
J. H. PENNEY,
Secretary.

EAST LONDON WATER-WORKS COMPANY.

ISSUE OF £125,000 THREE PER CENT. DEBENTURE STOCK.

MINIMUM PRICE, PAR.

NOTICE is Hereby Given, that the Directors are prepared to receive TENDERS for the above Issue (being the second portion of the £500,000 Debenture Stock, created under the East London Water-Works Company's Act of 1894), bearing Interest at 3 per cent. per annum less Income-Tax, and Redeemable after the expiration of 25 Years from the date of issue, subject to Six Months' Notice being given by the Company.

Minimum price, par.

Tenders must be delivered at the Company's Office, St. Helen's Place, Bishopsgate, E.C., not later than Eleven a.m., on Thursday, the 12th day of December ensuing.

Particulars and Conditions, together with Form of Tender, may be obtained at the said Offices, or will be forwarded on application.

By order of the Court of Directors,
I. A. CROOKENDEN,
Secretary.

St. Helen's Place, Bishopsgate, E.C.,
Nov. 13, 1895.

Limp Cloth. Price 6d.

ARCHITECTS AND SURVEYORS'

HANDBOOK OF GAS-FITTING.

(TABLES AND RULES BY ARTHUR H. CRUMP.)

JAMES STOTT AND CO., 174, Fleet Street, LONDON, E.C.

ISLE OF THANET GAS COMPANY.

SALE BY TENDER OF
FIFTY NEW SHARES OF £25 EACH.

Being part of Additional Capital authorized to be raised by Resolutions passed at a Special Meeting of Proprietors, held on the 20th of July, 1894, in pursuance of the powers of the Thanet Gas Act, 1877.

THE Directors of the Isle of Thanet Gas Company give Notice that they will be prepared to receive, not later than Ten o'clock a.m., on Friday, the 13th of December, 1895, sealed TENDERS for 50 SHARES of £25 each.

The Capital now offered is required for the Extension and Enlargement of the Company's Works.

The existing paid-up Capital of the Company is as follows:—

£40,000 Margate Consolidated Stock.
80 New £25 Shares fully paid-up.
£7000 Debenture Stock, 5 per cent. per annum.

The Consolidated Stock and the New Shares to be issued are entitled to a Dividend of 7 per cent., to be increased or diminished 5s. per cent. for every Penny charged in diminution or excess of the Standard Price of Gas—viz., Four Shillings and Twopence for 1000 cubic feet.

The Dividend on the Consolidated Stocks for the last Twelve Months was at the rate of 10½ per cent. per annum; and the Price of Gas, since September, 1895, 2s. 9d. per 1000 feet.

Forms of Tender can be obtained at the Gas-Works, Margate, or will be sent by post on application.

By order,
THOMAS C. FULLER,
Secretary.

Price 15s., Limp Cloth, the Fifteenth Yearly

ANALYSIS OF THE ACCOUNTS

OF THE

Metropolitan Water Companies,

Chelsea, East London, Grand Junction, Kent, Lambeth, New River, Southwark and Vauxhall, and West Middlesex—showing the Capital, Income, Expenditure, Profits, and Dividends per Million and per Thousand Gallons of Water supplied; the proportion of Expenditure and Profits to Gross Income; and the Income, Expenditure, and Profits per House, &c., supplied for the Year ended December 31, 1894, or March 31, 1895, together with the quantity of Water supplied, the estimated daily quantity supplied for domestic and other purposes, the quantity supplied per head of population, &c., &c., for the Year ended December 31, 1894.

Compiled and arranged by

ALFRED LASS, F.C.A.

LONDON: Walter King, 11, Bolt Court, Fleet St., E.C.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

NOTICE.

Whereas it has come to the knowledge of the INCANDESCENT GAS-LIGHT COMPANY, Limited, of Palmer Street, Westminster, that a Company called the Meteor Incandescent Lighting Company, Limited, has been promoted for the purpose of using and selling a form of Incandescent Gas-Light known as the "Meteor" Incandescent Gas-Light, and that such Gas-Lights are now being offered for sale throughout the Country.

This is to Give Notice that the Incandescent Gas-Light Company, Limited, are about to commence an Action for Infringement of their Patents against the said Company. Actions for Infringement will also be brought against all persons found dealing in any manner with the said "Meteor" Incandescent Gas-Light, which is constructed in infringement of the Patents of the Incandescent Gas-Light Company, Limited.

The validity of these Patents has been established; and a certificate to that effect has been granted by the Hon. Mr. Justice Romer.

FAITHFULL & OWEN,
11, Victoria Street, S.W.
olicitors to the Incandescent Gas-Light Company, Limited.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that a Firm of F. J. Putz & Co., 16 and 17, Great St. Helen's, London, are advertising for sale Incandescent Gas-Light Apparatus called the "Champion" Incandescent Gas-Burner, and are stating in their circular that such Apparatus may be legally sold throughout the United Kingdom without Infringement of any existing Patent.

This is to Give Notice to the Public and the Trade that Actions for Infringement of Patent and for an Injunction will be immediately commenced by the Incandescent Gas-Light Company, Limited, against any persons using or selling such Apparatus.

The validity of the Companys' Patents has already been certified by Mr. Justice Romer; and Solicitor and Client costs will be enforced in all cases.

FAITHFULL & OWEN,
11, Victoria Street, S.W.
Solicitors for the Incandescent Gas-Light Company, Limited.

NOTICE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, Hereby Give Notice, that they only supply their Mantles subject to the following express Conditions, which are printed and pasted on each box:—

"The Incandescent Gas-Light Company Limited, in supplying the Mantle contained in this box, grant a Limited License to the purchaser to sell or use the same on the express condition that neither the purchaser nor any other person into whose hands the same may come shall use or sell the said Mantle except in connection, or for use, with Burners sold or supplied by the Company; any other sale or use will amount to Infringement of the Company's Patents. The Company supply Mantles for the purpose of renewals at the nominal price of 1s. 3d., subject to the Conditions and Limitations above set forth."

In the case of *The Incandescent Gas-Light Company, Limited v. Cantelo*, Mr. Justice Wills upheld the Validity of these Conditions and Limited License; and, in the course of his Judgment, said:—

> The patentee has the sole right of using and selling the articles; and he may prevent anybody from dealing with them at all. Inasmuch as he has the right to prevent people from using them or dealing in them at all, he has the right to do the lesser thing—that is to say, to impose his own conditions. It does not matter how unreasonable or how absurd the conditions are. It does not matter what they are if he says at the time when the purchaser proposes to buy, or the person proposes to take a license: 'Mind I only give you this license on this condition;' and the purchaser is free to leave it or take it as he likes. If he takes it, he must be bound by the condition."

In the case of *The Incandescent Gas-Light Company v. Hirschfeld and Others*, the Honourable Mr. Justice Romer certified that the Validity of the Plaintiffs' Patents was established. Infringers in future will be liable to costs as between Solicitor and Client.

(Signed) FAITHFULL & OWEN,
Solicitors for the Incandescent Gas-Light Company, Limited.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS:—

Yield of Gas Per Ton . . 11,205 Cubic Feet.
Illuminating Power, $16\frac{7}{10}$ Stand. Sperm. Candl.
Coke (of good & pure quality) $13\frac{3}{4}$ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton . . 10,500 Cubic Feet.
Illuminating Power . 17 Stand. Sperm Candl.
Coke (of excellent quality) . $13\frac{1}{2}$ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor $94\frac{1}{2}$ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COAL-FIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.,
B Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

WE HAVE ACQUIRED

NEW ENGINEERING IRON, STEEL, & METAL WORKS

IN THE HEART OF THE MOST

Central & Cheapest

Coal and Iron Districts, and have made them complete with full equipment of

Specially Designed Tools and Appliances,

FOR THE

ECONOMICAL & EFFICIENT

PRODUCTION OF OUR

WORLD-FAMED SPECIALITIES.

ADDRESS ALL COMMUNICATIONS TO OUR HEAD OFFICE:

New CONVEYOR Co., Ld.,
Gas & Mechanical Engineers,
3 & 4, Lime Street Square, London, E.C.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.,
And at STROUD, GLOUCESTERSHIRE.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

THOMAS TURTON AND SONS, LIMITED,

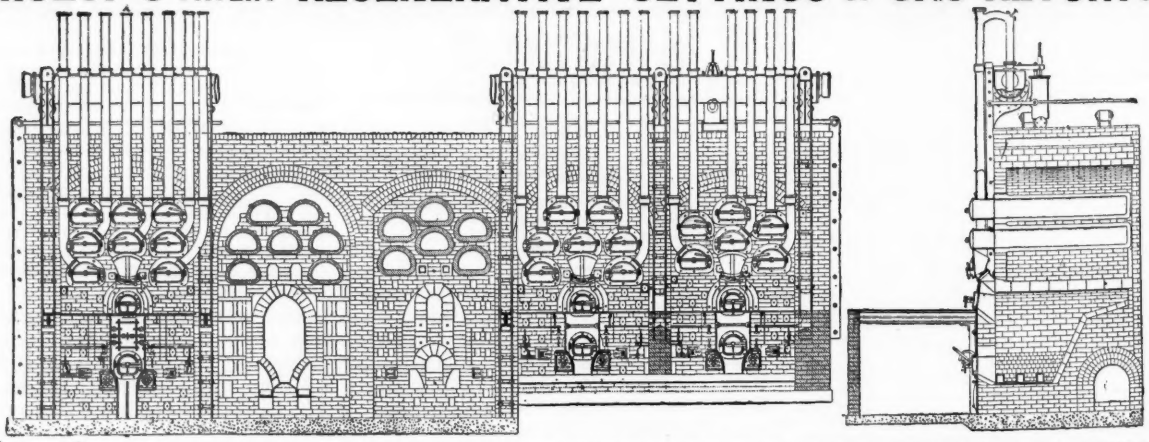
SHEAF WORKS, SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
PANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.

LONDON OFFICE:
90, CANNON STREET, E.C.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.
Further Information and Pamphlets from Principal Agent.

TROTTER, HAINES, & CORBETT,

Brettell's Estate

FIRE-CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.

Proprietors of

BEST GLASSHOUSE POT & CRUCIBLE CLAY.

Shipments Promptly and Carefully Executed.

London Office: R. Cull, 31, Old Broad St., E.C

THE SILICA FIRE-BRICK COMPANY,

OUGHTIBRIDGE, near SHEFFIELD,

MANUFACTURE

SILICA BLOCKS, BRICKS, AND CEMENT

OF SUPERIOR QUALITY

FOR GAS-FURNACES.

Trade Mark: "SILICA."

These Goods (largely used in Gas, Glass, Iron, and Steel Works) are, on account of their

GREATER DURABILITY,

Strongly recommended where EXCESSIVE HEATS have to be maintained.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,

for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,

Coal Owners, Newcastle-on-Tyne;

or

E. FOSTER & CO.,

21, John Street, Adelphi, London, W.C.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON & COAL Co., Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by

Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton	10,500 Cub. Ft.
Illuminating Power	16·9 Candles.
Coke (of good quality)	67·5 per Cent.
Sulphur	0·58 „
Ash	2·73 „

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.

QUAYSIDE, NEWCASTLE-ON-TYNE.

HUNTER'S

OXIDE OF IRON.

James Hunter, Miner, and Shipper of NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

Samples and Prices on application.

5, PRINCES STREET, PORT GLASGOW.

Telegrams: "Hunter, Port Glasgow."

Established 1872.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.

Output about 3000 tons per day.

Analysis—

Yield of Gas per ton	10,500	Cubic Feet.
Illuminating Power	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the

HARTON COAL COMPANY,

LIMITED,

Newcastle-on-Tyne.

W. H. PARKINSON,

Fitter.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,

COUNTY OF DURHAM.

Available output up to 5000 tons per day
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

For Prices and Particulars, apply to

S. J. DITCHFIELD,

SEAHAM HARBOUR, COUNTY OF DURHAM.

KENT'S THICK GAS COAL

RAISED AT

The Wharncliffe Woodmoor Colliery,

BARNSLEY.

Yield of Gas, nearly 12,000 *Cubic Feet per ton of Coal; and Illuminating Power nearly* 17½ *Candles.*

The following is a complete ANALYSIS made by Mr. R. O. PATERSON, C.E., Gas-Works, Cheltenham:—

Specific Gravity (Water 1)	1·276
Weight of One Cubic Foot	79·700 lbs.

PROXIMATE ANALYSIS.

Moisture in Coal	2·68 per cent.
Volatile Matter	35·60 „
Fixed Carbon	58·80 „
Sulphur	0·96 „
Ash	1·96 „

COMMERCIAL ANALYSIS.

Gas per Ton of Coal	11,760 cub. feet.
Gas per Cubic Foot of Coal	418 „
Illuminating Power	17·44 candles.
Value of One Cubic Foot in Sperm	418 grains.
Value per Ton of Coal in Sperm	703 lbs.
Coke per Ton of Coal	1367 „
Coke	61·05 per cent.
Ash in Coke	3·21 „
Sulphur Eliminated with Volatile Products per Ton of Coal	9·4 lbs.
Sulphur in Coke per Ton of Coal	12 „
Ammoniacal Liquor per Ton of Coal	19·7 galls.
Tar per Ton of Coal	12·2 „

R. O. PATERSON, C.E.

Gas-Works, Cheltenham, 8th August, 1894.

For Price, &c., apply to the

Wharncliffe Woodmoor Colliery Co

LIMITED

BARNSLEY;

Or to Mr. W. H. HARVEY,

17, Old Queen Street, Westminster, S.W.

"CANNELINE"

FOR ENRICHING COAL GAS.

Superior to the very Volatile Hydrocarbons; requiring only a simple apparatus, at quite a nominal cost.

Coal Gas enriched by "CANNELINE" shows conclusively this Hydrocarbon is vastly superior to all other Enriching Agents, including Cannel Coal. Reference will be given to several Works where its merits are Established after Two Years' use.

For all Particulars, apply to

S. BOWLEY & SON, Wellington Works, BATTERSEA BRIDGE, LONDON.

D. HULETT & CO., LTD.

55 & 56, High Holborn, London.

GAS SERVICE CLEANSERS.
LAMP TORCHES.

DRY GAS-METER MAKERS.

WROUGHT-IRON TUBES & FITTINGS.
STREET LAMPS & POSTS.

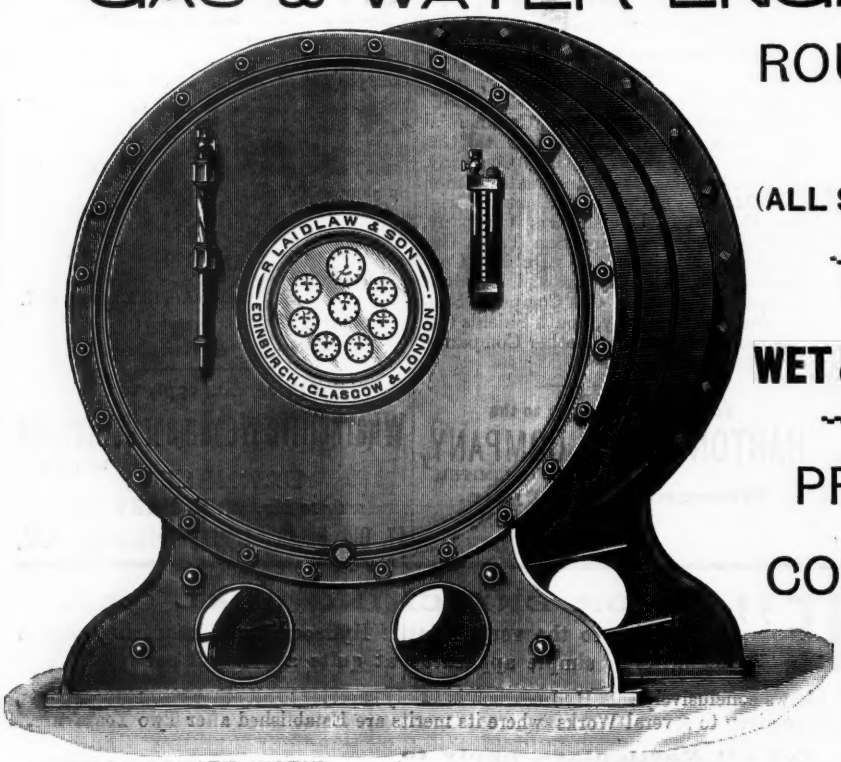
PRICE LISTS ON APPLICATION.

CLAYTON SON & Co., LTD.,

MAKERS OF LEEDS
LARGEST GASHOLDER IN THE WORLD
ALSO THE LARGEST METAL TANK IN THE WORLD
See Advertisement last week, also next week
MAKERS OF RETORT-LIDS OF ALL FORMS & SHAPES BY SPECIAL HYDRAULIC MACHINERY

R. LAIDLAW & SON

GAS & WATER ENGINEERS.



ROUND OR SQUARE
STATION
(ALL SIZES) METERS.

CONSUMERS'
WET & DRY GAS-METERS.

PREPAYMENT
AND
COMPENSATING
METERS.

SIMON SQUARE WORKS, EDINBURGH. | ALLIANCE FOUNDRY, GLASGOW. | 6, LITTLE BUSH LANE, LONDON, E.C.

ALL COMMUNICATIONS RESPECTING THE

INCLINED RETORT SYSTEM

SHOULD BE ADDRESSED TO

THE AUTOMATIC COAL-GAS RETORT COMPANY, LTD.,

Palace Chambers, 9, Bridge St., Westminster, S.W.

Telegraphic Address: "Robustness, London." Telephone No. 1756.

J. & H. ROBUS,

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And have now under Contract:—

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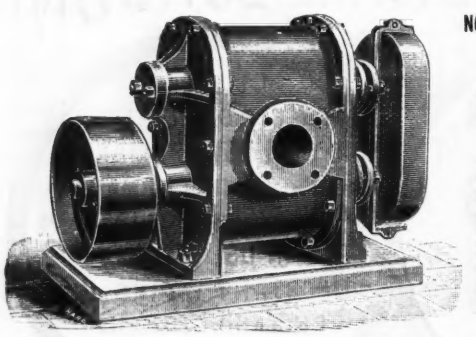

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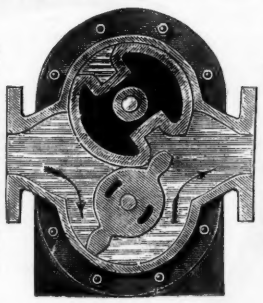

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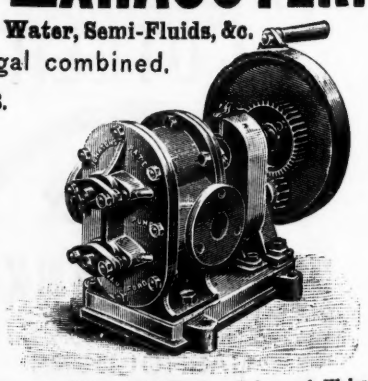

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[See Illustrated Advertisement, Nov. 5, p. 945.]

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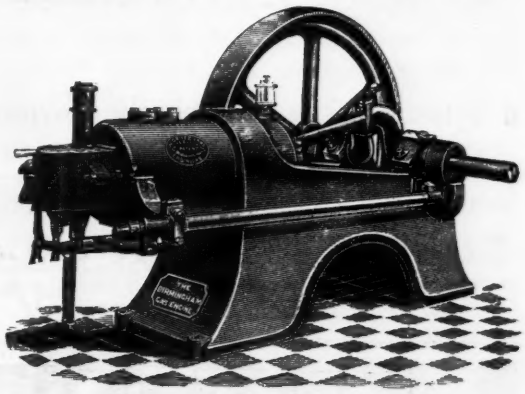

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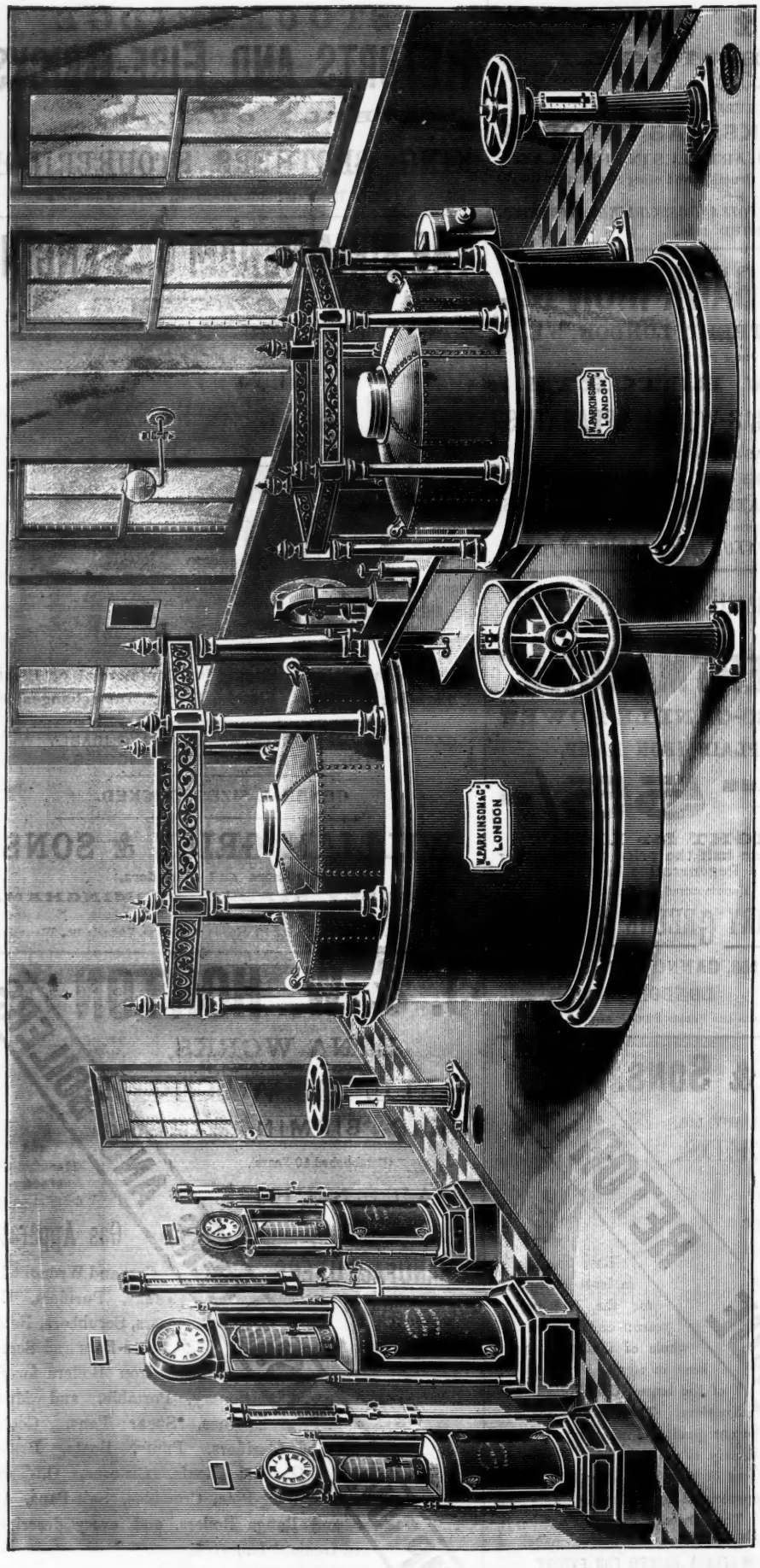

EQUILIBRIUM GOVERNORS. THE GASLIGHT AND COKE COMPANY'S VALVE-ROOM, STOKE NEWINGTON.

(TESTIMONIAL.)

The Gaslight and Coke Company, 146, *Goswell Road, E.C., Jan.* 5, 1893.

Gentlemen,—In reply to your inquiry as to the working of the 36-inch and 24-inch Governors (double cone and equilibrium) recently erected by you at the new Valve-Station of this Company, situated at Stoke Newington, I beg to inform you they are highly satisfactory in their working.

The gas governed is supplied through a high-pressure pumping-main; and, notwithstanding the great fluctuations in the initial pressure, owing to so many stations pumping and shutting off alternately, the construction of your Governors enables a perfect equilibrium to be maintained, and being acted upon themselves by outlet pressure only, they stand the most severe test to perfection.

I shall be happy to answer any questions, or show the Governors to Engineers contemplating their erection.

I am, Gentlemen, Yours faithfully,

(Signed) G. F. L. FOULGER, Distributing Engineer.

Messrs. W. Parkinson and Co.,
Cottage Lane, City Road, E.C.

W. PARKINSON & CO., LONDON, BIRMINGHAM.

[See also Advt., p. 1014.

London: Printed by Walter King (at the Office of King, Sell, and Railton, Ltd., 12, Gough Square); and published by him at 11, Bolt Court, Fleet Street, in the City of London.—Tuesday, Nov. 19, 1895.